illinois
november · 25¢

TECHNOGRAPH

Under fire, the performance of men and machines depends on what they are made of. United States Steel makes the materials for the machines, whether it's a very tough armor plate, or heat-resistant alloy, or Stainless Steels.

You might be interested in some of the USS steels developed specifically for aircraft and missiles:
USS Strux, an alloy steel with close to 300,000 psi tensile strength primarily for aircraft landing gears;
USS Airsteel X-200, an air-hardenable alloy steel with 230,000 psi yield strength for aircraft sheet and missile applications; USS 12MoV and USS 17-5 MnV Stainless Steels for high-speed aircraft and missiles;
Stainless "W", a precipitation-hardenable Stainless Steel.

New "exotic" metals, new methods for making them, present an exciting challenge. Men willing to accept this challenge—civil, industrial, mechanical, metallurgical, ceramic, electrical or chemical engineers have a future with United States Steel. Write to: United States Steel, Personnel Division, Room 2316,
525 William Penn Place, Pittsburgh 30, Pennsylvania.

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USS **United States Steel**

THE ILLINOIS TECHNOGRAPH

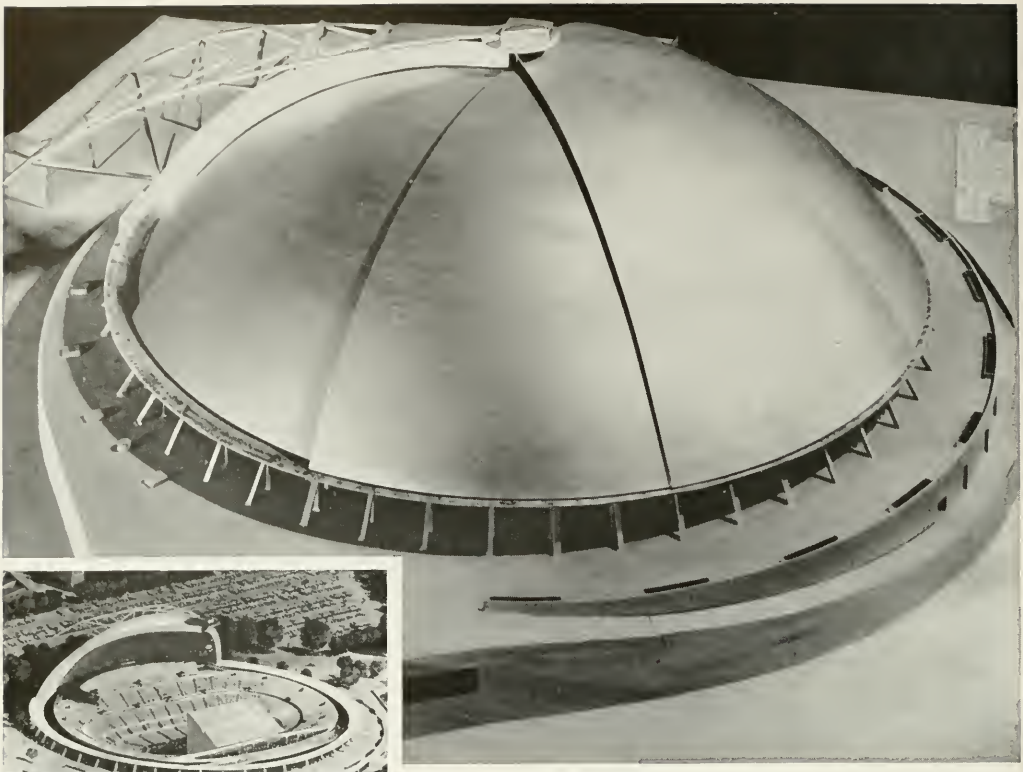
Volume 75, Number 2 November, 1959

Table of Contents

Cover . . .

Abstract art can often be as confusing as some of the abstract thinking in science. Yet, if the end result is something worth appreciating then the project is a success.

Barbara Polan has donated an example of abstract art for this month's cover.



All-weather auditorium in Pittsburgh will be covered by a 415-foot diameter Nickel-containing stainless steel dome. Largest of its kind in the world, the dome will protect an audience of more than 13,000.

For Pittsburgh's new auditorium...

A "push-button umbrella roof" of Nickel stainless steel ...the roof design of tomorrow

Here's the first of a revolutionary new type of roof design, destined to introduce a new concept in building.

A simple concept, but a daring one. The domed roof of a building is divided into eight sections which nest together when opened. Push a button, and six of these sections glide quietly together around an outside track.

In Pittsburgh's new all-weather auditorium, the push-button umbrella roof can be closed at the first sign of bad weather without disturbing the show. In private homes, a roof design like this could bring the beauty of nature right into the home.

But what material is lasting enough for a dome like this? Architects and designers of the auditorium looked into all types of materials. They selected Nickel-containing stainless steel. They selected Nickel stainless because it has the best combination of properties for this purpose. For example it is one of the most weather-resisting, corrosion-resisting metals.

Naturally, this is just one example of how designers are taking advantage of the unique properties of Nickel-containing metals. In the future, however, you may be designing a machine—not a spectacular all-weather push-button roof. You might need a metal that resists corrosion, or wear, or high temperatures. Or one that meets some destructive combination of conditions. Here, too, a Nickel-containing metal could be the answer.

But, whatever your field of study, in the future you can count on Inco for all the help you need in metal selection. Right now, if you'd like to get better acquainted with Nickel Stainless Steel, why not write Inco for "Stainless Steel in Product Design." Write: Educational Services, The International Nickel Company, Inc., New York 5, N. Y.

INCO **Inco Nickel** *makes metals perform better, longer*

Engineer Larry Klivans reviews the results of a computer-simulated ground checkout of Radioplane Division's near-sonic RP-76 rocket-powered target drone. Formerly at Norair Division, Larry came to Radioplane in 1955. At 31, he is Manager of the Division's 140-man Electronic Support Group, is working toward his doctorate at UCLA.

YOUNG ENGINEERS ARE NORTHROP'S NEWSMAKERS!

Northrop Corporation's dynamic and diversified corporate structure creates an ideal work climate for forward-thinking scientists and engineers. Our three autonomous divisions are all in Southern California – are all headed by progressive management eager to examine and try new ideas.

Let's assume that *you* are a man who can qualify for one of our engineering teams – a man who can create history!

YOU'LL EARN what you're worth, get increases as often as you earn them – based on your own individual achievements. Our salary structure is unique in the industry; our vacation policy extra-liberal, as are all of our other fringe benefits.

YOU'LL LEARN while you earn, with no-cost and low-cost education opportunities at leading Southern California institutions – earn advanced degrees and keep abreast of latest technological advances in your own chosen field.

YOU'LL WORK with men who are acknowledged leaders in their fields – men chosen for their own capabilities *and* for skills in guiding and developing the creative talents of younger men. And, these are men who delegate authority, assuring your fair share of credit for engineering triumphs.

YOU'LL BE FLEXIBLE – able to apply your talents to the work you enjoy, in the field best suited to your own inclination and ability. Northrop Corporation and its divisions offer wide diversity, with over 30 operational fields to choose from. All offer challenge aplenty – opportunity unlimited!

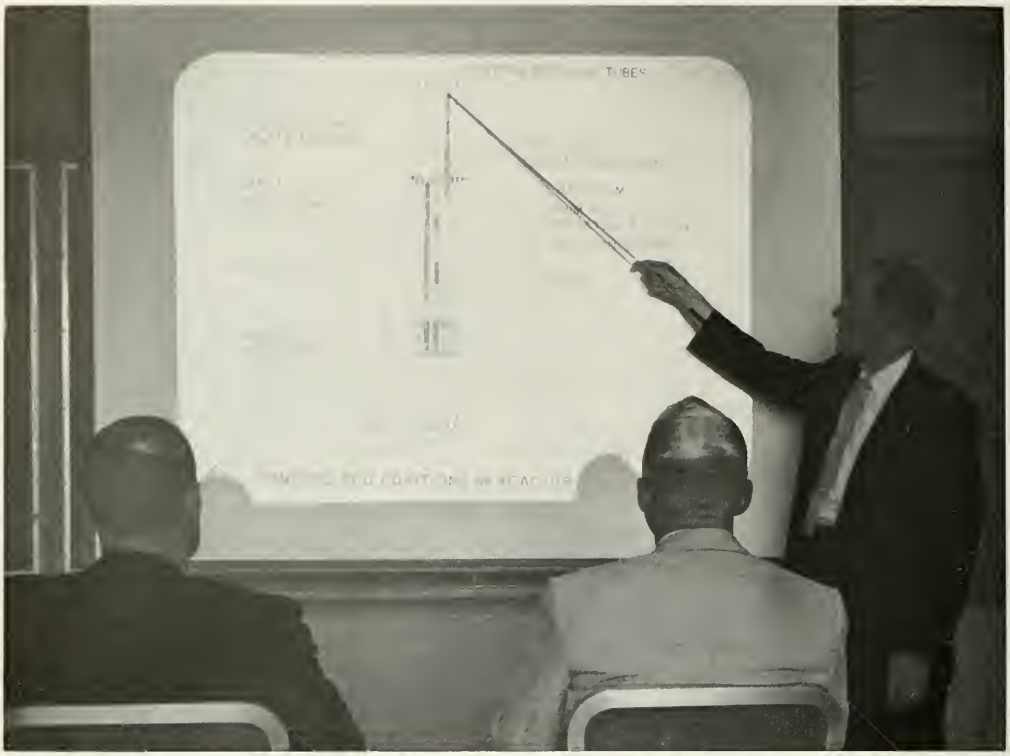
RADIOPLANE DIVISION. Creator of the world's first drone family; has produced and delivered tens of thousands of drones for all the U.S. Armed Forces. Now developing ultra-advanced target drone systems for weapon evaluation, surveillance drone systems, and missile systems.

NORTRONICS DIVISION. Pioneer in cetestial and inertial guidance. Currently exploring infrared applications, airborne digital computers and interplanetary navigation; developing ground support, optical and electro-mechanical, and data-processing equipment.

NORAIR DIVISION. Creator of SAC's intercontinental USAF Snark SM-62. Currently active in programs for the ballistic recovery of orbiting man; flight-testing the USAF T-38 supersonic trainer; readying the N-156F NATO-SEATO fighter for flight tests.

NOW WRITE! Get full information on Northrop Corporation and all of its Divisions. Then choose the division that offers *you* the most challenge. To reserve your spot where news is *happening*, write: Engineering & Scientific Personnel Placement Office, Northrop Corporation, P.O. Box 1525, Beverly Hills, California.

Divisions of NORTHROP CORPORATION



POWER AND PROGRESS go hand-in-hand . . .

America's progress depends upon a plentiful supply of electric power . . . and upon young engineers like those shown above who are preparing for the years ahead by learning how to harness the power of atomic energy to the job of producing electricity.

Opportunities for personal progress, too, are to be found in the electric industry. Wisconsin Electric Power Company's far-reaching expansion program requires engineering skills in a wide variety of fields — electrical, mechanical, civil, chemical, statistical, research, sales, administrative, etc.

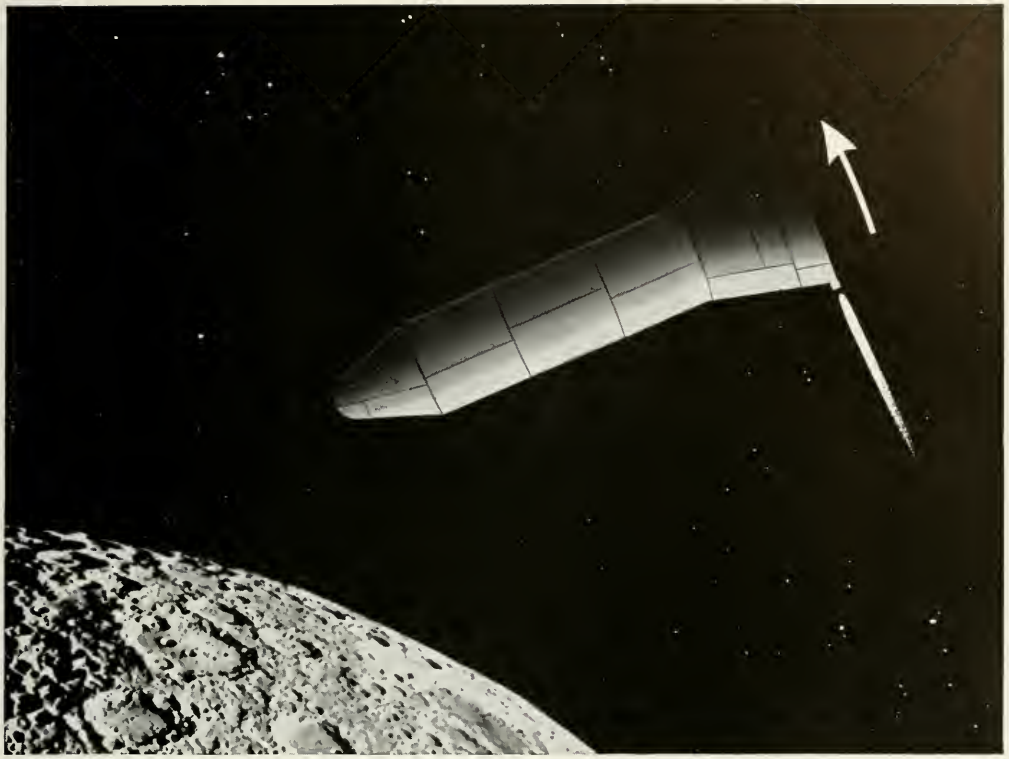
See our representatives when they visit your campus. Ask for more information about the excellent job opportunities available for engineers.

WISCONSIN ELECTRIC POWER COMPANY SYSTEM

Wisconsin Electric Power Co.
Milwaukee, Wis.

Wisconsin Michigan Power Co.
Appleton, Wis.

Wisconsin Natural Gas Co
Racine, Wis.



HOW TO MAKE A "LEFT TURN" IN OUTER SPACE

(and the "right turn" toward a gratifying career)

Like the dimensions of the universe itself, the future of space technology is beyond imagination. The frontiers of space will edge farther and farther from us as engineering and scientific skills push our knowledge closer to the stars. Bendix Aviation Corporation, long a major factor in America's technological advance, offers talented young men an outstanding site from which to launch a career.

In the field of controls alone, for example, Bendix (which makes controls for almost everything that rolls, flies or floats) has developed practical, precision equipment for steering and controlling the attitude of space vehicles. It consists of a series of gas reaction controllers (actually miniature rockets) which are mounted around the satellite. Individually controlled by a built-in intelligence system, they emit metered jets of gas on signal whenever it is necessary to change the orientation of the satellite.

The development of this unique control equipment is but one of the many successful Bendix projects involving knowledge of the outer atmosphere and beyond. Bendix, a major factor in broad industrial research, development and manufacture, is heavily engaged in advanced missile and rocket systems and components activities. These include prime contract responsibility for the Navy's advanced missiles, Talos and Eagle.

The many career opportunities at Bendix include assignments in electronics, electromechanics, ultrasonics, computers, automation, radar, nucleonics, combustion, air navigation, hydraulics, instrumentation, propulsion, metallurgy, communications, carburetion, solid state physics, aerophysics and structures. See your placement director or write to Director of University and Scientific Relations, Bendix Aviation Corporation, 1108 Fisher Bldg., Detroit 2, Mich.

A thousand products Bendix AVIATION CORPORATION Fisher Bldg., Detroit 2, Mich. *a million ideas*

COLLINS ELECTRONICS– diversification

These specialized electronics systems are an important part of Collins' contribution to advancements in military and commercial communication.

Collins was selected over several companies because it could do the job — economically, with excellent equipment, and provide capable engineering assistance for all phases.

Collins needs engineers and physicists to keep pace with the growing demand for its products. Positions are challenging. Assignments are varied. Projects currently underway in the Cedar Rapids Division include research and development in Airborne communication, navigation and identification systems, Missile and satellite tracking and communication, Antenna design, Amateur radio and Broadcast.

Collins manufacturing and R & D installations are also located in Burbank and Dallas. Modern laboratories and research facilities at all locations ensure the finest working conditions.

Your placement office will tell you when a Collins representative will be on campus.

For all the interesting facts and figures of recent Collins developments send for your free copies of *Signal*, published quarterly by the Collins Radio Company. Fill out and mail the attached coupon today. You'll receive every issue published during this school year without obligation.

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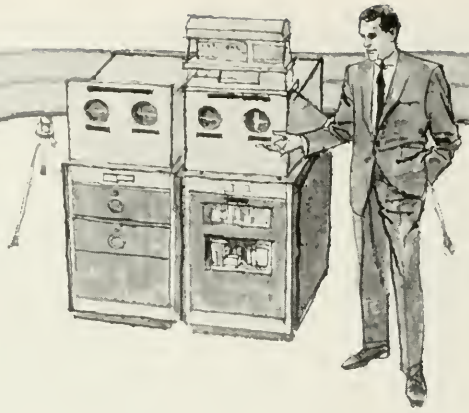


Thinking far up the road ...in electronics

The automatic highway, demonstrated in this working model of General Motors experimental Auto-Control System, is an electronic marvel that takes over steering, speed, braking and obstacle detection for drivers.

GM positions now available in these fields for men holding Bachelor's, Master's and Doctor's degrees:
Mechanical Engineering
Electrical Engineering
Industrial Engineering
Metallurgical Engineering
Chemical Engineering
Aeronautical Engineering
Ceramic Engineering
Mathematics
Industrial Design
Physics • Chemistry
Engineering Mechanics
Business Administration
and Related Fields

If you're thinking ahead in the field of science or engineering, General Motors is the place for you. Here are many challenging opportunities for young men who want to do things, do things better, solve problems on projects that probe into the future.

Among many available fields and products in which GM engineers and scientists work are: electronics, rocket propulsion, automotive, solar energy, astronautics, diesel engines and household appliances.

GM has plenty of room in which you can grow. As you move forward, you take on jobs of greater responsibility in your Division and can bridge across to positions of responsibility in other Divisions of the Corporation. And if you wish to continue with advanced studies, GM offers financial assistance.

For more information on a fine position with an exciting future, write to General Motors, Personnel Staff, Detroit 2, Michigan.

GENERAL MOTORS

DOW is tomorrow-minded **people** . . .

A chemist, with his mind on his own specialty exclusively, might say: "The chief raw materials for Dow products are sea water, brine, petroleum, coal, oyster shells." Up to a point he would be right. But in fact he would be overlooking the most important ingredient of all—people of a certain exceptional kind and quality of mind.

Let's look at a quick profile of the kind of person Dow looks for. His mind and ambitions are not limited by the dimensions of the job he is doing. His horizons take in tomorrow, while he does his job well today. Problems appear to him in a dynamic context of both today *and* tomorrow. The "big picture" is not just a cynical phrase to him.

This broader view makes him plan well—for his family as well as for his job. As the phrase goes, he is "a good provider." He owns his own car. Chances are he owns his own home. Along with some 80,000 others he has invested in Dow stock because he believes in his company and wants to back up that belief with cash.

He is a builder at work or in his community. He gets a kick out of creating new things. Such products as Saran Wrap*, Separan* for the mining industry, the new fiber Zefran*, and others. Making things that do some important job for the human community, better than it has ever been done before, gives him a real thrill.

Not everyone who works for Dow, whether at Midland or the other 23 United States locations (plus 23 foreign and 5 Canadian), fits this profile. But by and large most of those who do well tend to. Though they have more than their share of "creative discontent," they have found a good place to grow, and work out their hopes, plans and ambitions.

If you would like to know more about the Dow opportunity, please write: Director of College Relations, Department 2427FW, THE DOW CHEMICAL COMPANY, Midland, Michigan.

*TRADEMARK

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN DOW

Leonardo da Vinci...on experiments

"I shall begin by making some experiments before I proceed any further; for it is my intention first to consult experience and then show by reasoning why that experience was bound to turn out as it did. This, in fact, is the true rule by which the student of natural effects must proceed: although nature starts from reason and ends with experience, it is necessary for us to proceed the other way around, that is — as I said above — begin with experience and with its help seek the reason.

Experience never errs; what alone may err is our judgment, which predicts effects that cannot be produced in our experiments. Given a cause, what follows will of necessity be its true effect, unless some external obstacle intervenes. When that happens, the effect that would have resulted from the cause will reflect the nature of the obstacle in the same proportion as the obstacle is more or less powerful than the cause."

—Notebooks, circa 1500

THE RAND CORPORATION, SANTA MONICA, CALIFORNIA
A nonprofit organization engaged in research on problems related to national security and the public interest

To the Seniors . . .

On this campus in years past there were many traditions. The bench at the southwest corner of the Union Building was for Seniors only. It was a privilege reserved for those who had gone through registration week for three years and had come back for more. They had sweated their hour exams and probably done poorly on some of them, but at least they were still around.

No one knows better than an engineer the work that lies behind a person in his senior year, and he should also realize the work that lies ahead. He soon finds that the senior year is more hurried than ever.

But while all the seniors seem to be working as hard as each other and striving for the same ultimate goal, they lack something best described as **espirit de corps.** I speak of a feeling for their fellow classmates as well as the school which has given them as much education as they are willing to obtain.

There used to be another tradition on this campus. Every male student would say hello to every other male student, regardless of whether he knew him. Obviously, with the growth of our campus this is impossible; however, the engineering campus could incorporate something of this nature.

Another idea is that of a special shirt or hat for the seniors. If this seems silly, then look at the U. S. Army which has as standard a uniform as could ever be wished on a person, and yet some students wear parts of it to class (and rather proudly I suspect).

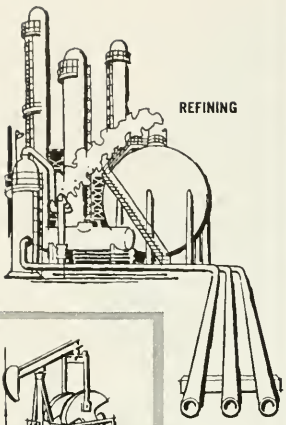
The solution to the problem may be something much simpler. Forget the whole idea. "We're seniors. We'll be out soon, so why bother?" The point is just that. We will be out soon, and what have we got to show for it besides the ability to analyze an engineering problem?

Industry is looking for a person with a touch of the "gung-ho" in him, and the willingness to let it show.

Why not let it show now, while you are in with a group of men who are doing and wanting the same things you are? Let it show some, and you as well as the school will benefit by it.

—WDP

COMPUTER PROGRAMMING

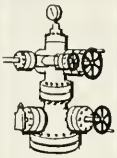


REFINING

PRODUCTION

PETROLEUM PRODUCTS

EXPLORATION



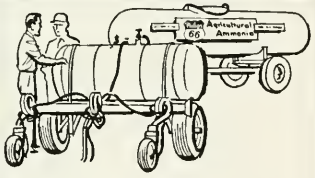
NATURAL GAS

LAND & GEOLOGICAL

CARBON BLACK

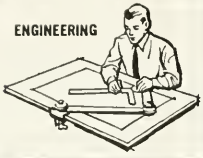
RESEARCH & DEVELOPMENT

URANIUM MINING & MILLING

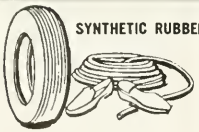


FERTILIZERS

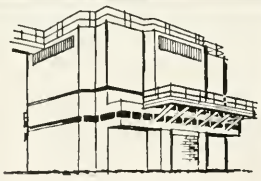
PLASTICS



ENGINEERING



SYNTHETIC RUBBER



ATOMIC ENERGY

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Phillips Petroleum Company is one of America's largest and most widely diversified producers of petroleum, natural gas, natural gas liquids and petrochemicals. Having recently completed a billion-dollar expansion program, Phillips is now entering a new period of growth.

Phillips is a research and engineering-minded company, where one out of every eight employees is a technical graduate! These men are working on such broadly diversified projects as synthetic rubber, atomic energy, fertilizer, rocket fuels, plastics and new processes for improved motor fuels, lubricants and other petroleum products.

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Phillips policy of promotion and transfer from within is creating opportunities for young engineers and scientists who will be our key men of tomorrow.

Write *today* to our Technical Manpower Division for our latest brochure . . . and when the Phillips Representative visits your campus be sure to arrange for an interview through your Placement Office.

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PHILLIPS 66

An Announcement of Importance to Engineering and Physical Science Majors

Lockheed Missiles and Space Division is engaged in a broad spectrum of scientific exploration. The Division has complete capability in more than 40 areas of technology – from concept to operation.

Diversity of the work areas is typified by the programs in such fields as: magnetohydrodynamics; space medicine; oceanography; sonics; propulsion and exotic fuels; metallurgy; advanced systems research; manned space vehicles; reconnaissance; optics and infrared; electromagnetic wave propagation and radiation; electronics; physics; chemistry; mathematics; computer design; aero and thermo dynamics; test; design and operations research and analysis.

PROJECTS—Current major projects include the Navy POLARIS Fleet Ballistic Missile; the DISCOVERER program; MIDAS and SAMOS; Air Force Q-5 and X-7 and the Army KINGFISHER. PROJECT MIDAS is an early warning infrared system against ballistic missile attacks, based on the use of satellites. PROJECT SAMOS is designed for the development of an advanced satellite reconnaissance system. DISCOVERER, MIDAS, and SAMOS are programs of the Advanced Research Projects Agency under the direction of the Air Force Ballistic Missile Division with Lockheed as systems manager.

LOCATIONS—You have a selection of two of the choicest living areas in the country at Lockheed. Headquarters for the Division are at Sunnyvale, California, on the San Francisco Peninsula. Research and development facilities are located in the Stanford Industrial Park in Palo Alto and at Van Nuys, in the San Fernando Valley of Los Angeles. Testing is conducted at Santa Cruz and Vandenberg AFB, California; Cape Canaveral, Florida; and Alamogordo, New Mexico.

Together, the Division's facilities occupy more than two million, six hundred thousand square feet of laboratory, engineering, manufacturing and office space and provide the latest in technical equipment, including one of the most modern computing centers in the world.

OPPORTUNITIES FOR ADVANCED EDUCATION—For those who desire to continue their education and secure advanced degrees Lockheed maintains two programs. The Graduate Study Program permits selected engineers and scientists to obtain advanced degrees at the company's expense while working part time at Lockheed.

The Tuition Reimbursement Plan remits fifty per cent of the tuition for approved evening courses for salaried employees who are working full time.

For Information regarding career opportunities at Lockheed, please write Professional Placement Staff, Dept. K-96, Lockheed Missiles and Space Division, 962 West El Camino Real, Sunnyvale, California, or see your Placement Director for date of Lockheed campus visit.

Lockheed / **MISSILES AND SPACE DIVISION**

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA

CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO • HAWAII

Westinghouse mathematicians Burnham Moffat and Dr. Richard Durstine check on an electronic computer working out solutions to a heat transfer problem for the company's Atomic Power Division.

The Mathematics Department helps you to use high-speed computers to solve your problem

The Mathematics Department helps Westinghouse engineers take advantage of modern methods of mathematics and new developments in this field. If new techniques are needed to use a digital computer for solving an engineer's problem, these men will develop them.

This department, the second of its kind in American industry, is staffed by 15 Ph.D.'s, 3 M.S.'s, and 6 B.S. mathematicians. Among other accomplishments, it is credited with developing OPCON, an electronic brain for optimizing control of processing systems. OPCON won for Westinghouse the 1958 Industrial Science Achievement Award of the A.A.A.S.

Supporting the work of about 150 other mathematicians with operating divisions, the Mathematics Dept. is actively studying industrial logistics (called OR or Operations Research by some), fatigue of metals (pioneering work using statistical techniques), equipment and system design, and a variety of other challenging problems.

The young engineer at Westinghouse isn't expected to know all of the answers. Our work is often too advanced for that. Each man's work is backed up by specialists—like the men in this Mathematics Dept. Even tough problems are easier to solve with this kind of help.

If you've ambition and real ability, you can have a rewarding career with Westinghouse. Our broad product line, decentralized operations, and diversified technical assistance provide hundreds of challenging opportunities for talented engineers.

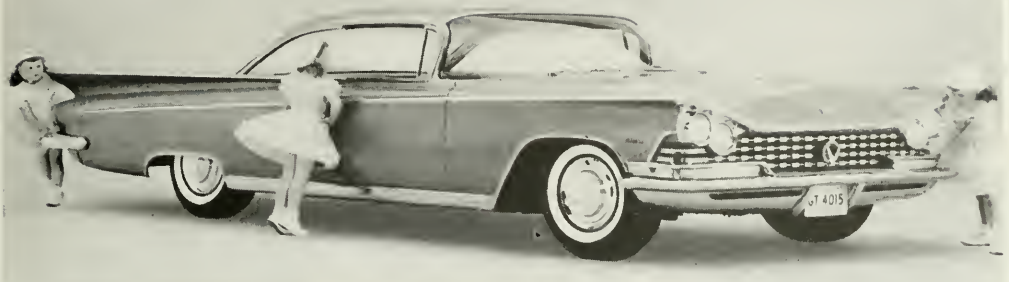
Want more information? Write to Mr. L. H. Noggle, Westinghouse Educational Dept., Ardmore & Brinton Roads, Pittsburgh 21, Pa.

YOU CAN BE **SURE**...IF IT'S

Westinghouse

WATCH WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS
CBS-TV FRIDAYS

New products create
more good jobs at Du Pont



HOW LONG WILL IT STAY BRIGHT AND SHINY?

That depends, for the most part, on its finish. The most dazzling cars on the road today wear gleaming coats of Du Pont "Lucite"* acrylic lacquer. For "Lucite" stays bright and beautiful three times longer than the best conventional finishes.

Like hundreds of other products developed through Du Pont research, "Lucite" has created all kinds of new jobs. Jobs in the laboratory. Jobs in production. And jobs in sales and marketing. *Good* jobs that have contributed substantially to the growth of Du Pont and the prosperity of our country.

It's an old story. But it's truer today than ever. For the very nature of our business makes research pay off, giving us the courage to "obsolete" products when better ones are found. This is probably why our sales have increased more than tenfold during the last twenty-five years. And for every dollar we have spent on research during these years, we have been able to invest three in new production facilities.

What does all this have to do with you?

For qualified bachelors, masters, doctors, career opportunities are greater today at Du Pont than ever before. There is an interesting Du Pont future for metallurgists, physicists, mathematicians, electrical and mechanical engineers, and other technical specialists, as well as for chemists and chemical engineers.

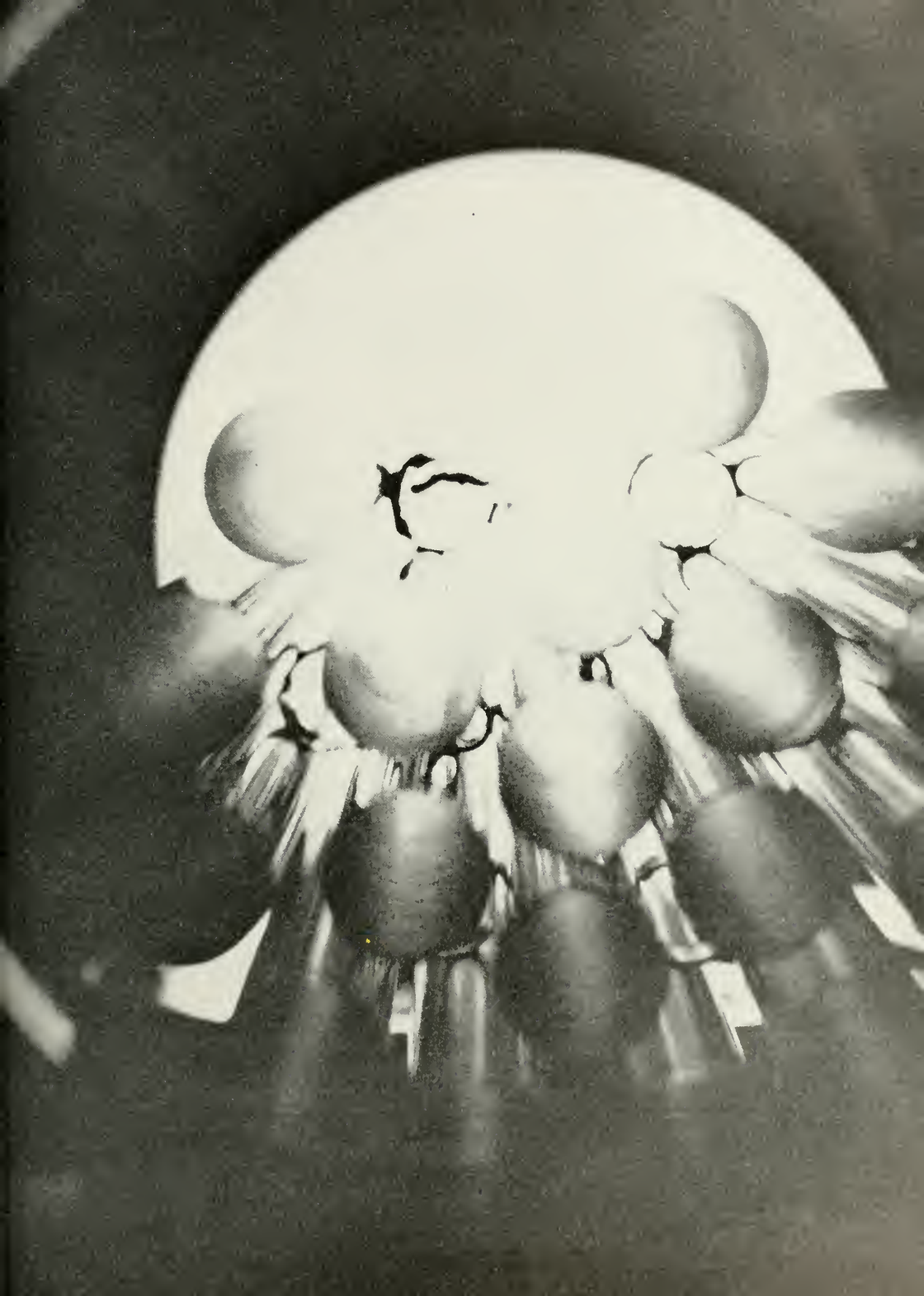
You probably won't discover a "Lucite," nylon or neoprene, or develop a revolutionary new process, your first year. Nobody expects you to. But you will be given responsibility from the very start, along with training that is personalized to fit your interests and special abilities. Our advancement policies are based on the conviction that you should work at or near the top of your ability. For as you grow, so do we.

If you would like to know more about career opportunities at Du Pont, ask your placement officer for literature. Or write E. I. du Pont de Nemours & Co. (Inc.), 2420 Nemours Building, Wilmington 98, Delaware.

**"Lucite" is Du Pont's registered trademark for its acrylic lacquer.*

DU PONT

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



Ceramics and Nuclear Engineering

By Jim Blome

There is a great need for new materials that can be used in atomic reactors. These materials must be capable of withstanding not only high temperatures, but also corrosive environments and radiation damage. A few of the ceramic materials that have been used for this work will be discussed along with the problems that arise from their use.

There are a variety of special conditions on materials used in the construction of a reactor. The core of a thermal reactor must be made up of elements having a low probability for capturing neutrons. The bulk of the core must be of light elements in order to slow down the neutrons for the atomic reaction. This eliminates most of the elements from consideration. The control rod which is inserted in the core must be made of elements having high neutron capture probabilities. The particle shield which is around the core must absorb neutrons without the emission of gamma radiation. The radiation shield which goes around the particle shield must be very dense to absorb the harmful radiation that is emitted.

The effects of bombardment of fission products, neutrons, beta particles and gamma radiation, called radiation damage, place still another big restriction on the material that is to be used in the construction of reactors.

Extracting the heat which is produced in the reactor is done via a coolant which gives rise to corrosion problems never thought of at normal temperatures.

The ceramists and metallurgists have done a remarkable job in meeting the difficult materials requirements of reactors.

Oak Ridge

Two types of research reactors are operated at Oak Ridge National Laboratory. One is a graphite moderated, air-cooled, natural uranium reactor; the second is a water-cooled and moderated, enriched uranium reactor.

The graphite reactor was first built as a pilot plant for the Hanford plant, but since 1944 has been used as a research reactor. There are three ceramic materials used in this reactor: graphite, concrete and glass (in the form of glass wool). Together they make up the bulk of the reactor.

The size of the graphite core is 24x 24x24 ft., and is entirely surrounded by a concrete shield seven feet thick. The graphite is fitted together from blocks 4x4x48 in. in size which are keyed to prevent shifting. About 600 tons of graphite are built into the reactor. The shield is composed of three layers of concrete; a one foot thick wall of standard concrete on the inside and outside and the five feet in the center which is filled with a special concrete containing barytes to increase the density, thus making the shield more effective in absorbing gamma rays. The concrete also contains haydite (an expanded clay material) to give the structure a high water content and thus make the shield more effective. The water has the property of absorbing neutrons. The mass of uranium in the reactor is 54 tons and is formed into cylinders commonly called slugs. These slugs are 1.1 in. in diameter by 4 in. long and are enclosed in aluminum jackets. The aluminum "can" is to prevent oxidation of the uranium.

Approximately 90,000 c.f.m. of cooling air is filtered through coarse glass wool filters and through channels in the graphite. After flowing through the channels and thus removing the fission heat from the uranium slugs, the air is taken through a long duct of concrete to a filter house. Here the air is filtered again through glass wool fibers and special paper filters which remove all particles above one micron in diameter. This process is very important since some of the slugs rupture and put radioactive fission products in the air. The air is drawn from the filter house by two 900 h.p. centrifugal compressors and is discharged at the top of a 200 ft. stack. The stack is necessary because of radioactivity in the cooling gases. The radioactive part of the gas is largely Argon-41. Fortunately, this does not have a very long half life (about 100 minutes) and the radioactivity decays before the gases reach the ground level.

Another factor which limits the kind of material that can be used in reactors is radiation. In some ceramic materials the low temperature thermal conductivity is appreciably decreased by radiation. Nearly all of the electronic properties of the nonmetals are altered by bombardment of fission products.

Although the present state of knowledge in the field of radiation damage makes it hard to give a complete picture of the best materials to use, two things seem to be most important in radiation stability. The most stable materials are those which are ionic and which have a high symmetry. Experience with graphite indicates that, if it is necessary to use anisotropic materials, the best results will be obtained with small particle sizes and a minimum of preferred orientation.

Urania

In view of the fact that UO_2 is a very important ceramic material used in reactors, a short summary of some of its physical and chemical properties will now be discussed. Uranium dioxide has been used as a reactor material for fuel elements both in bulk and granular forms. Uranium dioxide is a dark brown material in powder form. Its crystal structure is the face centered cubic CaF_2 type, the uranium ions occupying corners and faces.

The melting point of UO_2 is stated by most investigators to be about 2800°C and sintering has been noted at temperatures as low as 1400°C. Some furnace walls, after sintering, have been colored and radioactive, indicating the volatility of UO_2. If BeO is present it becomes even more volatile.

Some of the chemical reactions with uranium that have been noted are:

With Carbon—UC_2; U_2C_3

With Hydrogen—No reaction up to melting point.

With Oxygen—UO_2; U_4O_9; U_3O_7; U_2O_5; U_3O_8

With Oxides—Solid solutions with ThO_2 & ZrO_2

With Silicon—USi_2

With Aluminum—UAl_4; UAl_3

With Columbium—Solid Solution at 1000°C containing an unknown phase.

Urania is formed into many shapes by

←

Ceramic systems are being considered as fuel element material here at Atomics International, a division of North American Aviation, Inc.

such ceramic fabricating processes as: cold pressing, slip casting, extrusion, and hot pressing. Urania bars and pellets, for example, are made by pressing UO_2 powder plus a few per cent dextrose or wax binder in a steel die at 10,000 psi. All of these forming methods are common to the ceramic industry and much work has been done by ceramists on nuclear fuel.

Crucibles, cylinders and other hollow thin wall shapes are made by slip casting a water-urania mixture, plus HCl as a deflocculant, in an ordinary plaster mold. This method of forming ceramic materials has been used by manufacturers for many years, although different deflocculating chemicals may be used in different casting slips.

Refractaries

In the reactors which use uranium as a fuel there is a need for special shaped fuel components. Some of the refractories which have been used for casting and melting this metal are Magnesium Oxide, Calcium Oxide, Thorium Oxide and Aluminum Oxide. These special molds and crucibles are formed by slip casting and dry pressing, just as are many other ceramic products.

In slip casting alumina, a very fine powder of it is used along with bentonite, ball clay and distilled water. A one-eighth inch wall thickness can be attained in about one minute in a plaster mold. Alumina can also be dry pressed using a modified polyethylene glycol or binder.

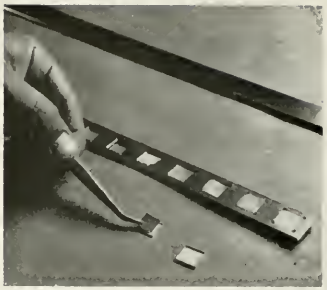
Some ceramic bodies which are made for nuclear applications need special consideration in their preparation. Bodies made of urania must be fired in a partial vacuum or in some other inert gas atmosphere, because urania upon heating in the presence of oxygen converts to U_3O_8 causing a destructive volume increase. It has been found that bodies containing 30 percent urania and 70 per cent thoria (by weight) can be fired in the air by adding U_3O_8 to the thoria, thus producing a solid solution, with no flagrant volume change. This product has become more popular because of the ease of firing.

A higher temperature reactor has been proposed using more ceramic materials. This reactor would make for more efficient production of power. With the fuel, moderator and breeder planket in ceramic form and gas as a coolant this reactor could operate at higher temperatures and could be more efficient according to the Carnot cycle. The Carnot cycle asserts that the efficiency of a heat engine is increased if the spread between the temperatures of the incoming and outgoing gases can be increased. The high temperatures attainable (above 1000°C) in a ceramic reactor would make this increase in efficiency possible.

Applications

It is said that much of our nations electrical supply will soon come from atomic energy. This is especially probable in regions where there is little natural supply of power like water or coal. Atomic power plants today provide light for the homes of less than 200,000 Americans. In three years, however, that total should soar to about 2,000,000. It has been predicted that 20 per cent of our electrical power will come from nuclear sources by 1980.

On July 21, the first American-built nuclear-powered merchant ship was



Physical ceramists at Atomics International investigate inter-particle relationships of refractory oxides.

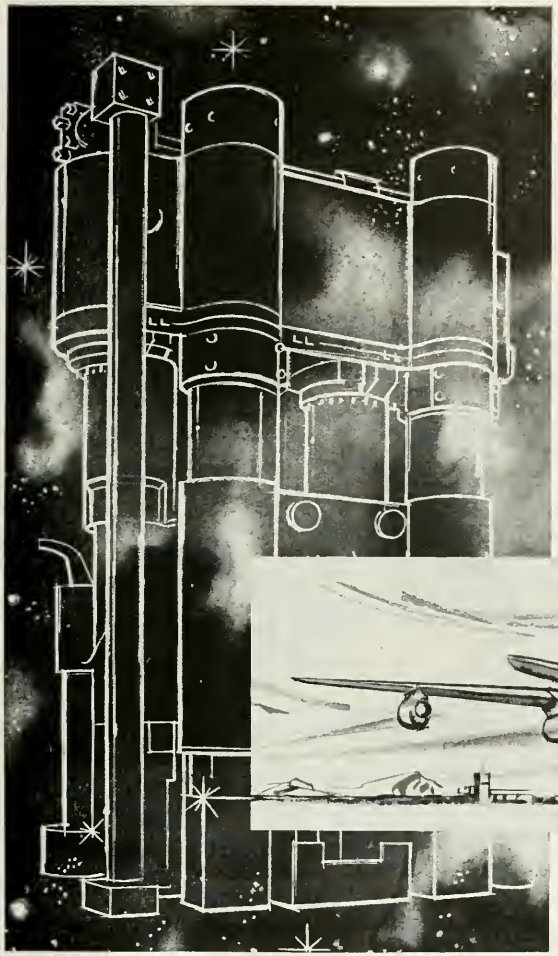
christened at Camden, N.J. and there are others now in the building stage. Nuclear power has also made history in the able hands of the United States Navy. There is no other source of power that could have driven a submarine thousands of miles under the polar ice cap.

By 1962, the Air Force hopes to have nuclear-powered airplanes and a few years later commercial planes of this type may be in the test stage.

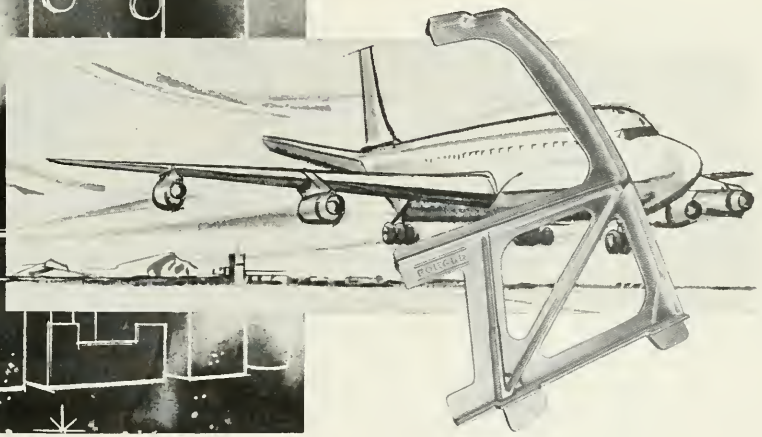
Mines being worked with nuclear power equipment and trains of nuclear design have been predicted by the middle 1960s.

Ceramics will have a strategic role in power reactors of many types in years to come. There will be many problems involved in adapting ceramic materials to the various conditions under which they will be used in nuclear reactors but, if progress in this field continues as it has, these problems will be taken in stride.

Main Research Building at Oak Ridge National Laboratory



HOW FORGED PARTS help airplanes haul bigger payloads



In an airliner, every pound of weight saved is worth hundreds of dollars ... in revenue-making payload. And in military aircraft, pounds saved mean added miles-per-hour ... or added load carried.

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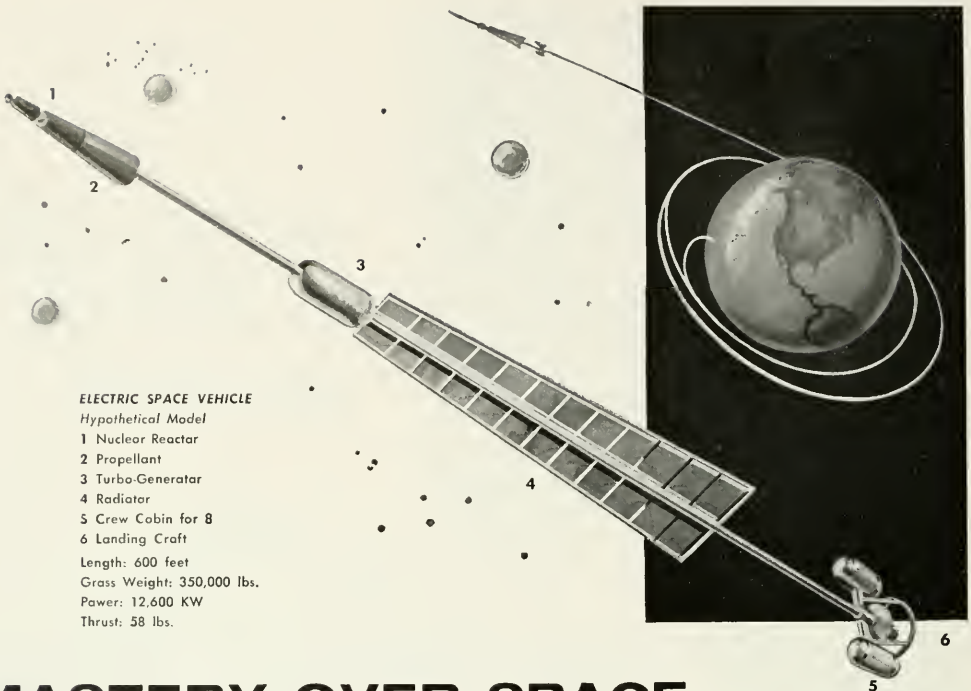

ELECTRIC SPACE VEHICLE
Hypothetical Model
1 Nucleor Reactar
2 Propellant
3 Turbo-Generatar
4 Radiator
5 Crew Cobin for 8
6 Landing Craft
Length: 600 feet
Grass Weight: 350,000 lbs.
Pawer: 12,600 KW
Thrust: 58 lbs.

MASTERY OVER SPACE

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NASA National Aeronautics and Space Administration

MATHEMATICS FOR THE SPACE AGE

By Dean H. L. Wakeland

On October 4, 1957, a new age was born when the Russian satellite Sputnik orbited the earth and shocked many Americans into the realization that Russia's space technology had not only equaled but surpassed American space technology. Immediately cries rang from all corners of the United States for the causes of our failure in the space program. One area which was immediately singled out as a great weakness was our educational system. More emphasis was placed on mathematics and science in education than ever before.

However, the high schools in the State of Illinois were several years ahead of the space program in their planning for better mathematics programs. In 1950 the College of Engineering proposed a change in the mathematics requirements for entrance into college and the Illinois high schools immediately began to upgrade their mathematics programs. A brief review of entrance credits presented by the freshmen in the College of Engineering from the years 1952 through 1959 indicates the planning and achievement made by Illinois high schools.

Freshmen in the College of Engineering come primarily from Illinois high schools and therefore the entrance credits they present indicate the college preparation available in Illinois. In 1950 the mathematics entrance requirements for the College of Engineering were one and one-half years of algebra, one year of plane geometry, and one-half year of solid geometry. At that time approximately sixty per cent of all entering freshmen met these requirements. In 1953 the College of Engineering raised its mathematics requirements to two years of algebra, one year of plane geometry, one-half year of solid geometry, and one-half year of trigonometry. In 1956 the one-half year of solid geometry was dropped as a requirement in hopes that high school students would replace solid geometry with the study of advanced mathematics. Since the latest change in 1956 the entrance requirements have remained at three and one-half years of high school mathematics.

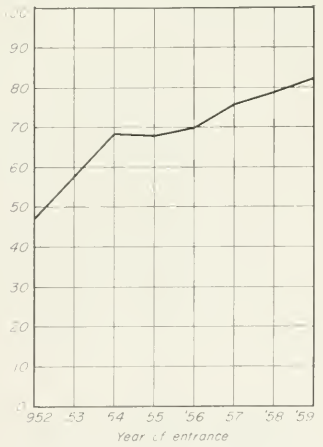
The response of the Illinois high schools to this upgrading of college entrance requirements has been extremely gratifying. The graph below indicates the continued improvement in the preparation of high school students. In 1952 only 47% of the students entered with three and one-half years of mathematics including trigonometry. That figure has now risen to 82.2% and continues to rise each year. An even sharper contrast is shown in the comparison of students having had four years of high school mathematics. In 1952 only 27% of the freshman class had four years of high school mathematics, whereas, in 1959, 70% had four years of high school mathematics.

Illinois high schools have also added college level courses to their offerings during the past ten years. In 1952 only a few of the engineering freshmen presented college credit in algebra or trigonometry, but in 1959 nearly 15% of the class did so. In addition, an increasingly larger number of students are entering the College of Engineering each year with college credit in analytic geometry and integral or differential calculus. In 1959 twenty-six engineering freshmen were placed in the first course in calculus and 5 in the second course in calculus.

The alumnus who complains "students aren't as good as when I was here" would be enlightened if he were to review the statistics of each new incoming class. The quality of the engineering freshmen class continues to improve each year. In 1952, 59% of the incoming freshmen came from the upper thirty per cent of the high school class, whereas, in 1959, 66% came from the upper thirty per cent. Likewise, the Engineering freshmen in 1959 offered more entrance credits in areas other than mathematics than any class before them.

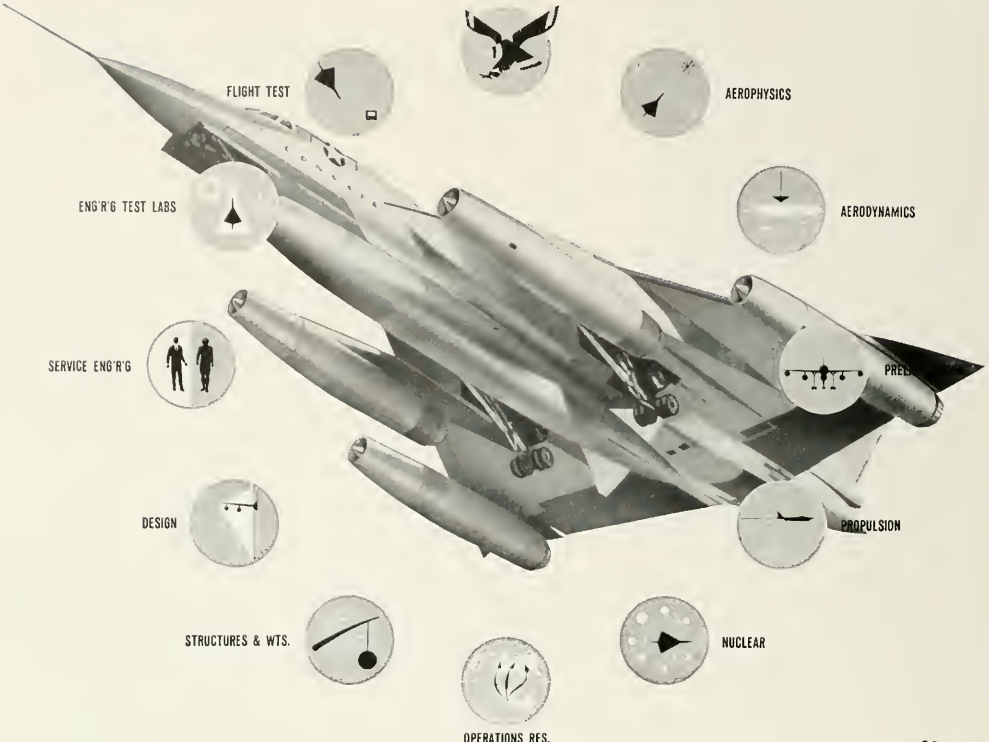
It seems that engineering freshmen can always find many things to be corrected in the high school from which they came, but seldom do they realize the good points of their high school background. The high schools in the State of Illinois are to be commended for their high standards and continued progress in making their mathematics program one of the strongest in the nation. Studies and improvement programs are being carried out in other educational areas and a comparison might show similar progress.

The College of Engineering is again studying its entrance requirements in areas other than mathematics and there is a possibility that other entrance requirements will be changed in the future. The fundamentals of mathematics as in any other educational area, have not been changed by the so called "Space Age," but the excellence required in educational areas is definitely higher than ever before. Illinois' high schools not only have realized this fact but had instrumented programs to meet their new challenge before Sputnik was fired.



Percent of the Engineering Freshman Class presenting 3½ years of high school mathematics.

"Best individual effort...



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YOUR TASK FOR THE FUTURE

Since its inception nearly 23 years ago, the Jet Propulsion Laboratory has given the free world its first tactical guided missile system, its first earth satellite, and its first lunar probe.

In the future, under the direction of the National Aeronautics and Space Administration, pioneering on the space frontier will advance at an accelerated rate.

The preliminary instrument explorations that have already been made only seem to define how much there is yet to be learned. During the next few years, payloads will become larger, trajectories will become more precise, and distances covered will become greater. Inspections will be made of the moon and the planets and of the vast distances of interplanetary space; hard and soft landings will be made in preparation for the time when man at last sets foot on new worlds.

In this program, the task of JPL is to gather new information for a better understanding of the World and Universe.

"We do these things because of the unquenchable curiosity of Man. The scientist is continually asking himself questions and then setting out to find the answers. In the course of getting these answers, he has provided practical benefits to man that have sometimes surprised even the scientist.

"Who can tell what we will find when we get to the planets? Who, at this present time, can predict what potential benefits to man exist in this enterprise? No one can say with any accuracy what we will find as we fly farther away from the earth, first with instruments, then with man. It seems to me that we are obligated to do these things, as human beings."

DR. W. H. PICKERING, *Director, JPL*

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Tau Beta Pi Essay . . .

LANGUAGE *and* LEADERSHIP

By Tom Gabbard

As the world grows smaller, the opportunities for United States industries to exploit the world's resources are becoming increasingly advantageous. Many industries have already taken the giant step into world-wide operations. The oil industry is a prime example. In response to these new opportunities, our oil industries have established operations in South America, Africa, and Asia.

This movement abroad has created a great demand for engineers who are willing to work in these foreign lands. However, the supply of men who are qualified to take these jobs has been very limited. The limitation is the inability of American Engineers to speak another language. It is well past the time to remedy this situation. Until high schools begin to fulfill this need more satisfactorily, our universities need to install an effective program to teach our engineers how to speak to the nationals of other lands.

In all of the educated foreign countries of today there is some program of dual language instruction. Many young students learn to speak two or three languages before they are even in high school. This accomplishment seems like a miracle to us. However, the achievement is very real. Many American educators have realized this fact and are encouraging programs for primary schools. However, these programs are still in the experimental stage. It will be many years before these schools are turning out students who are bilingual. I met a good example of just what we should strive for when I visited Brazil last summer. I stopped a young man of about fourteen years of age on the street and asked for some assistance. The boy apologized for not being able to speak English very well. He said that he had only been studying it for three months. However, he asked if perhaps I could speak Portuguese, Spanish, or French. I very humbly apologized to him and asked him to try his English.

If the American universities had men like this young Brazilian for students, they would have no problem. As it is, we are not likely ever to approach this criterion for many years. The universities must revise their curriculum in order to satisfy this crying need. It may be hard for many people who have never thought of traveling abroad to realize that this problem is important. However, these people will one day be awakened. Two of this country's most eminent engineers visited Paris this summer for a world conference and were brought face to face with this very problem. Since the conference was held in France, it was assumed by everyone except our engineers that the official language would be French. As the conference progressed, it became apparent to everyone that these two men were being left completely out of the discussion. When this situation was discovered, the official language was changed to English. This unfortunate situation caused a great deal of embarrassment for our representatives. Similar situations may also cause much ill feeling toward our country.

In many of our universities, the engineering students waste much time each semester taking survey courses that are of little value to them. This time could be spent in learning to speak foreign languages. With the new techniques for training that have been developed, a student should have no difficulty in learning a language well while in college. Such a program would lend emphasis to the programs of the secondary and primary schools. Students in college preparatory curricula would realize the need to increase their talents.

The engineer of today must be a man of many talents. He is being called into the fields of management, of sales, of administration, and of leadership. As life becomes increasingly mechanized and work becomes increasingly technical, the leadership is going to become the most important aspect of the profession. If the engineer is not fully capable of meeting this challenge, our country will soon lose its position as the world leader. We can not long retain our position if we cannot speak to, or understand the customs of, our friendly neighbors. In this age engineering is tantamount to leadership, and leadership is paramount in success. We must prepare ourselves for these responsibilities.


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TECHNOGRAPH LAUNCHES SATELLITE

As Recorded by George Carruthers

On October 21, 1959, members of the *Technograph* staff, in cooperation with the college of engineering, placed the world's first cat-carrying vehicle, Katnik 1, into orbit around the earth and later brought it back safely.

This tremendous achievement was the result of over a year of top-secret work. In fact only a few bearded Cossacks caught the squeal before the Cat's meow was broadcast around the world. Cat lovers were overjoyed although they were at first concerned about putting a cat and dog in the same space.

The rocket, built wholly on campus, had a small launching vehicle. This first stage was powered by a new and radical means of propulsion developed at the University of Illinois. A hydrogen-oxygen-carbon chain produced by means of a catalyst of heat and smoke was bonded in such a manner as to produce a new high energy fuel—H-O-O-C-H.

The power of this combination as a propellant was discovered a few years ago by a couple of chem e's doing unsponsored research. They had decided to keep the results of their experiment secret; however, hearing of the need for such a fuel for the project, they threw their caution to the wind. During the first test run, the thrust of the Atlas Vernier engine used in the first stage was nearly doubled.

The second stage of the two-stage vehicle was also powered by a high- energy propellant. However, two full professors worked on this stage, so a solid propellant was used.

The engine section of the first stage, which was assembled by the aero department, weighed only 100 pounds complete with shell and pumps. This phenomenally low figure surprised even those who planned the stage. Upon checking, it was found that someone had forgotten to install the engine. This hiked the weight to 175 pounds.

About the same time, the question came up as to the type of research to be carried out with the proposed satellite. A faculty member in the home economics department suggested inclusion of one of his pastries aboard the satellite so that the University could claim the world's first "pie in the sky." However, this idea was rejected because of lack of space, weight considerations and the added complications necessary to eject the pie into orbit.

The biology department suggested an animal experiment for study of space medicine. They thought of using mice. However when a cat wandered into the lab, they changed their minds and sent the cat instead. Besides supplying useful medical data, sending the cat enabled the department to resume their experiments with rodents.

The satellite proper which housed the cat was mounted atop the solid-propellant second stage, which in turn was mounted on a spin-stabilization turntable just above the guidance system of the first stage. (see diagram)

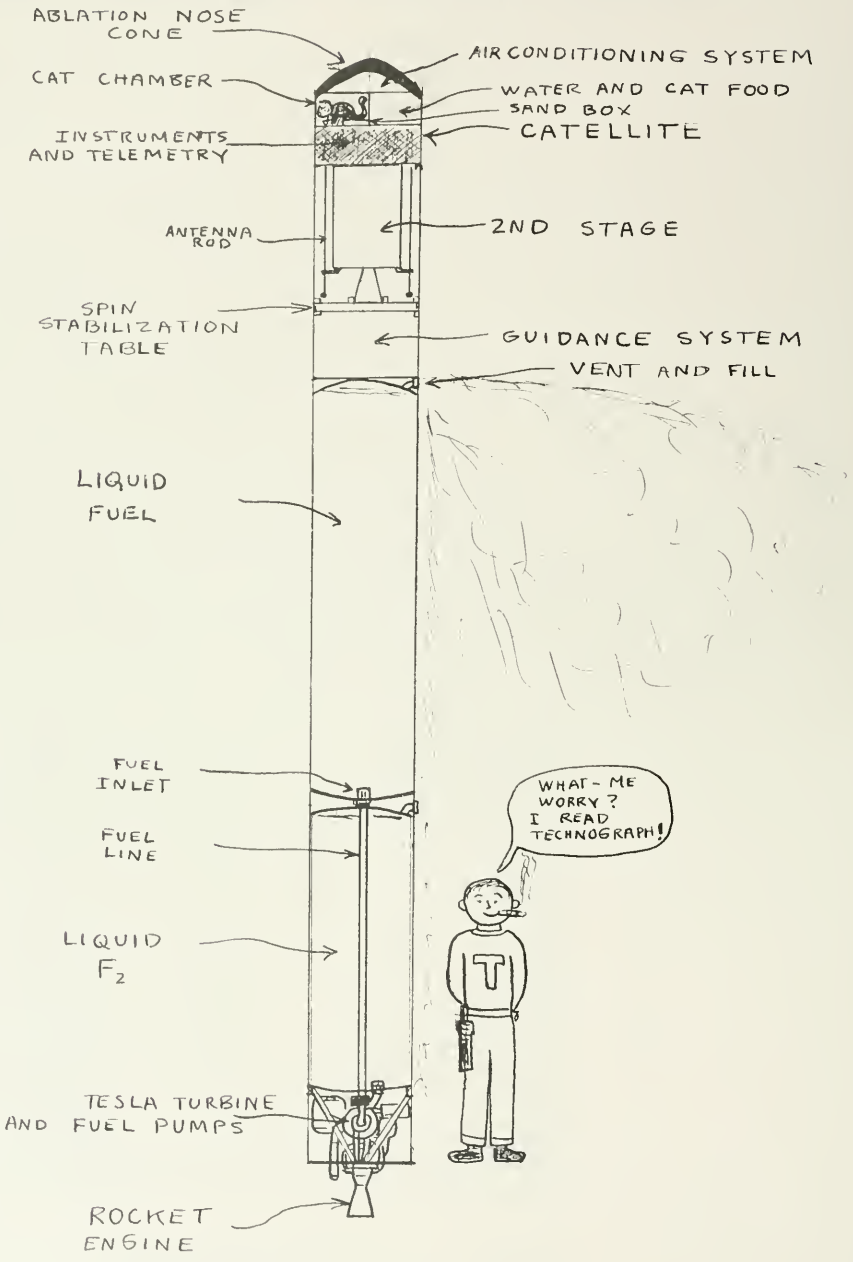
Housed in the satellite were air, water, food and a sandbox for the cat. Also on board were time-lapse cameras loaded with color film, radio telemetering devices and recovery equipment which included a radio beacon and dog repellent. The electronic equipment including the entire guidance system of the rocket vehicle was completely the work of students and faculty members of the electrical engineering department.

Design of the vehicle and catellite

(Continued on Page 29)

TECHNOGRAPH staff makes last-minute adjustment on rocket

U. of I. "KATNIK" SATELLITE ROCKET



Flunkout I is placed in satellite

(Continued from Page 27)

was carried out by sections of G.E. 100.

Working on the assumption that new blood was best for a project such as this, the students were given incentive by hearing strains from "They said it couldn't be done . . ."

Construction of the vehicle was begun late in September in the aero lab. By the middle of October, construction and preliminary tests were completed.

The tests came through with only one hitch during a static test of the first stage—it blew up. But muttering "back to the drawing board," the workers gained new incentive and the stage was completely rebuilt. The rest of the tests and the launching of the vehicle were then placed in the hands of the Technograph staff. They were considered dispensible.

While the tests went on, arrangements were made to track the vehicle. Members of the U. of I. Astronomy Club volunteered to track the vehicle visually, using binoculars and small telescopes confiscated from students in back of a women's housing unit.

It was planned to launch the vehicle in a north-south direction so the cat would be in the Van Allen belt of radiation for as short a time as possible. The planned perigee was to be 120 miles and the apogee 400 to 600 miles. This would allow the second stage and catellite to orbit the earth from 10 to 30 times before drag caused them to fall into the earth's atmosphere. The second stage would burn up, but the catellite would be recovered.

On the night of the launching, the Astronomy Club was notified that countdown was in progress. All planes at the airport were grounded and the Civil Air Patrol was notified to keep planes out of the area. At 1:17 a.m. on the morning of the 21st, fueling began. Preflight checkouts were completed with only two holds, once when a crew member walked up to the hydrogen fueling truck smoking a cigar, and once when it was discovered that a mouse had gotten into a compartment of the catellite near the one occupied by Flunkout, the cat. This mistake caused quite a commotion over the microphone in the second stage as would be expected.

At 3:45 a.m. the countdown reached the final ten seconds. All was clear, so at X minus zero the firing signal was given. The ignition button was pushed. The rocket simply sat on the pad. "Missile does not lift," was the word. Disappointment showed on the faces of all present; it seemed certain the shot would have to be scrubbed. Just then, one of the crew members walked in with a sheepish grin on his face. He stammered, "I'm uh sorry, fellows, I er-uh forgot to put the batteries in."

The project boss went into action. There was a thud of shoe leather against denim. The crew member sailed through the door in a parabolic arc and plopped down at the base of the launching pad.

(Continued on Page 42)

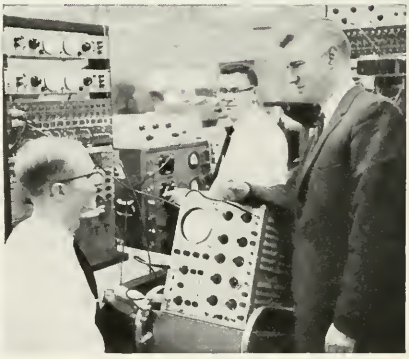
Product Development at IBM

IBM Engineer Richard R. Booth explores electronic frontiers to develop new, faster and larger storage devices for tomorrow's computers.

Computing time cut from six months to one day

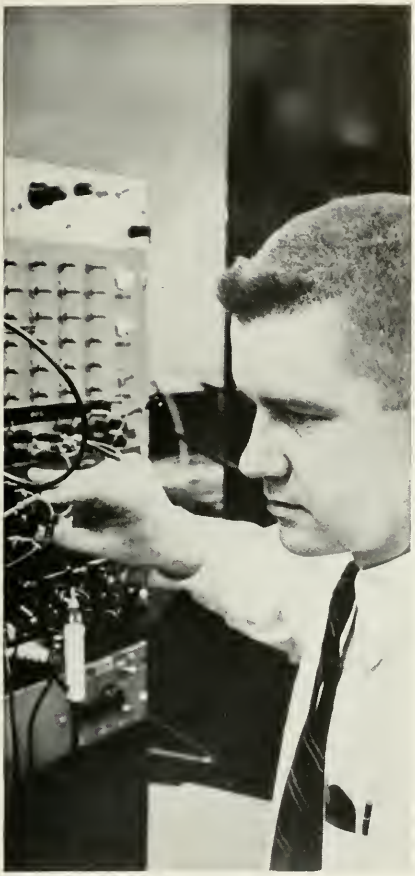
"My job is to design and develop new, high-speed storage devices for a powerful new computer that will perform, in one day, operations requiring six months on present equipment," said Dick Booth as he began a typical day recently. A product development engineer at the IBM Laboratories in Poughkeepsie, N. Y., he started his morning with a conference on a product of great interest to him: a magnetic core storage device with a nondestructive read-out feature. For an hour, he discussed with circuit design engineers the logical devices needed for the register—such as magnetic core drivers and sense amplifiers. Should such devices not be available, the group would work on designs for new ones.

Dick Booth next met with members of the Magnetic Materials Group to establish specifications for the magnetic core memory elements to be used in the register. He also discussed with the group the development of equipment to test the memory elements. "This magnetic core register is based on an original idea of mine," he explained. "When you have a worthwhile idea, you will be given a free hand in proving it out, backed by IBM's resources — plus the assistance of skilled specialists."



Increasing responsibility

At 10:30, Dick Booth reviewed the status of the entire project with the two engineers, two technicians, and one logic designer who make up his team. "My present position is staff engineer," he explained. "It's the second promotion I've had since I joined IBM three years ago with a B.S.E.E. degree from the University of Illinois. I know that there are plenty of other opportunities to move ahead. Furthermore, parallel advancement opportunities exist for engineers in either engineering development or engineering management."



Preparing for the future

In the afternoon, Dick Booth went to the 704 Computing Center to supervise some complex precision computations. "You see how quickly the 704 arrives at the answers," he said. "The computer being developed is expected to multiply more than 500,000 fourteen-digit numbers a second and add them at the rate of one million a second. The computer may be used for design computations for reactors, as well as calculations of satellite behavior. Of course it should have hundreds of other applications."

At 3:30 P.M., Dick Booth attended a weekly class on Theoretical Physics that lasted until 5:00. Afterward, he commented, "You know, IBM offers excellent educational opportunities both in general education and for advanced degrees. One of the engineers in my group has just received his Master's degree from Syracuse University, after completing a postgraduate program given right here at the IBM Laboratory."

A chance to contribute

As he was leaving for the evening, he said, "Yes, I'd recommend an IBM career to any college graduate who wants to exercise his creative ability. IBM will appreciate his talent and he'll have the opportunity to work with specialists who are tops in their fields. I doubt that he'd be able to find a more sympathetic and stimulating atmosphere. Furthermore, he'll have the added incentive of contributing to vitally important projects . . . projects that will take him to the frontiers of knowledge in computer electronics."

* * *

Talented college graduates will find exciting, rewarding careers at IBM. Excellent opportunities are now available in Research, Development, Manufacturing, Applied Science, Sales, and Administration. Find out from your College Placement Office when our interviewers will next visit your campus. Or, for information about careers of interest to you, write to:

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IBM Corporation, Dept. 839
590 Madison Avenue, New York 22, N. Y.

IBM®

No Hipsters These

By Bob Westerbeck

He pressed the Minister of Destruction's urgent button. The screen focused, faded, and came into focus again. "Priority, Sir. I suggest you alert the planet for eventual attack. preparedness condition one—Sir! Did you get my message?"

"Sorry, 94, I had to plug my translator in. This blasted English! Yes, it's as we thought; the missiles are coming from earth. They're very crude all the same, hardly enough to warrant preparedness condition one. Are you sure you're not losing your touch, 94?"

"On the contrary, Sir, my faculties were never keener. I believe that Mars or the Jupiter moons want us to believe the missiles are from earth. They hope to lull us into complacency, into the belief we have nothing to fear for a century or two. At an unsuspected moment, they'll disguise their disintegrator missiles as harmless earth missiles and destroy us before we realize the danger."

"An interesting possibility 94, but what makes you so sure the missiles are launched by enemies disguised as earthmen and not by earthmen themselves?"

"As you know, Sir, I frequently visit the fraternal organizations on a planet for information. The inhabitants seem more talkative in such an atmosphere. Accordingly, I spent an hour in a place called Tony's Cellar Club in one of the larger cities here on earth."

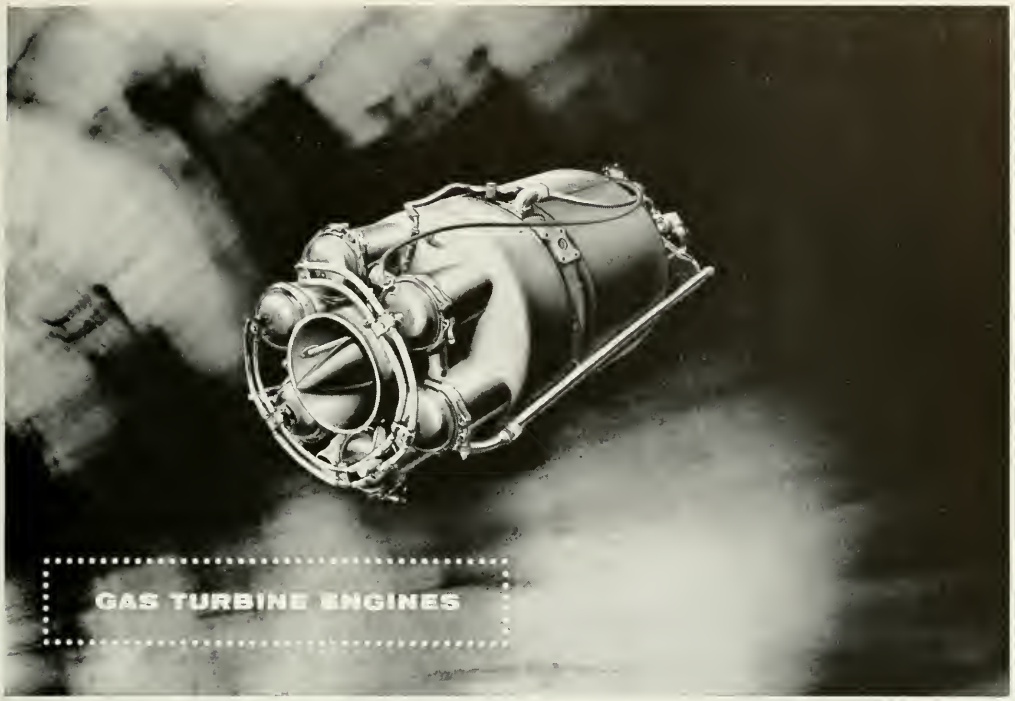
"Yes, yes, 94. Get on with it! I have an execution scheduled shortly."

"Yes, Sir. It was very close and warm inside, and the light was very bad. The atmosphere was full of smoke from what they called cigarettes. There were three earthlings manipulating musical instruments called a horn, a set of skins, and a bass. The music was appallingly primitive, and the earthlings seemed to be in a high state of barbaric passion. They swayed, clapped their hands, had glassy eyes, and seemed hypnotized in general. There were various couples at tables who embraced each other periodically in their ardor. I assume they still reproduce their race physically, a sure sign of inferior cultural evolution. Also, their language has not progressed to the point we had thought. For instance, I asked an earthling what the title of the music was. He told me not to be square, that it was a session, and that it was real crazy. Well, Sir, it appears that the earthlings worship insanity, which is what crazy means. More significantly, I think, I had not assumed the geometrical square form, which would indicate the earthling was having hallucinations."

"Is that all, 94?"

"No, Sir, there's more. This earthling asked me if I dug the music. I thought perhaps if I humored him, I could draw him into my confidence. I told him I didn't because I had no shovel. He laughed loudly, for no apparent reason, and told me I was a gasser. I must confess I was a little offended. We certainly have more humane methods of execution than gas. Well, Sir, he said I fractured him, even though I hadn't so much as touched him. He called a few more earthlings over, and said he wanted them to meet a real square. I was a little shaken at this point. I thought perhaps I had inadvertently assumed the square form. I looked over my entire form, and it was that of an earthling. It seems that they were all metally unbalanced, Sir. He then told me I was cool, man, cool. It must have been a rare lucid moment for him, since he recognized my form for that of a man. Well, I told him I wasn't cool at all, on the contrary, I told him I was very hot. The whole group went into hysterics at this point, probably at some prearranged signal I didn't catch. I presumed they were working themselves into a savage orgy of some sort, so I left and came back to the space sled and contacted you. That's all I have to report, Sir."

"Very good, 94. It appears quite obvious that the earthlings are themselves incapable of developing missiles. No further verification will be necessary in view of the conclusiveness of this report. The planet's strategic position as a shield for our enemies poses a serious threat to our civilization. I will take the appropriate steps now that we know nothing important will be lost.



• The small gas turbine is an important aircraft support item used primarily for starting jet engines and providing on-board auxiliary power. The high compressed air and shaft outputs for its small size and weight mark it as an important power source for common commercial use. AiResearch is the largest producer of lightweight gas turbines, ranging from 30 H.P. to the 850 H.P. unit pictured above.

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Diversity and strength in a company offer the engineer a key opportunity, for with broad knowledge and background your chances for responsibility and advancement are greater.

The Garrett Corporation, with its AiResearch Divisions, is rich in experience and reputation. Its diversification, which you will experience through an orientation program lasting over a period of months, allows you the best chance of finding your most profitable area of interest.

Other major fields of interest include:

• **Aircraft Flight and Electronic Systems** — pioneer and major supplier of centralized flight data systems and other electronic controls and instruments.

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Should you be interested in a career with The Garrett Corporation, see the magazine "The Garrett Corporation and Career Opportunities" at your College placement office. For further information write to Mr. Gerald D. Bradley...

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—Photos by Dave Yates

Technocutie . . .

JUDY COSME

Technograph's November Technocutie is a girl that likes to go to Kam's jam sessions and one that would like to learn more of the songs here on campus.

Judy Cosme, a freshman in Home Economics, thinks parties are fun. Also high on her list of date ideas are going to the movies, out to eat or dancing. Other things she likes to do are swim and ice skate. Sweater and skirt type dates are best to her thinking.

More than jazz or Dixieland, rock 'n roll is Judy's favorite type of music.

Judy says she doesn't get on the engineering campus much, and that she doesn't know much about engineering. When asked about Einstein's theory of relativity, she replied, "What's that?" Perhaps there is an engineer that would be willing to explain.

The things that make a fellow rate with her are clean-shaven faces and promptness on dates. Judy likes men's clothes especially the new Continental pants that are becoming popular. She says she has seen some sharp dressers on campus, but not all fellows quality. Sweaters and slacks are the clothes she likes on a fellow. She would rather not see a fellow in Bermudas.

This semester Judy is living in LAR. She said she heard about the water-fights U. of I. is famous for and thinks it would be "neat" to have one.

Judy's favorite foods are the fattening kind; but she also likes steak, candied apples and pretzels with her favorite beverage.

Judy emphatically says that girls are not at college to catch a man. She admits that there may be some who are but that they are the exceptions. Her reasoning is to take into account the number of girls that do graduate and get jobs. Also she feels that if a girl weren't here to go to school, she would take only easy courses and courses that she likes.

Judy likes school although she thinks it is hard. Because she has a hard time writing, freshman rhetoric scores low with her.

Typically female, Judy likes the hen sessions at LAR. It is easy for her to talk study time away.

Judy would like to date engineers, and she has no preferences as to type.

engineers

and what they d

The field has never been broader
The challenge has never been greater

Automatic systems developed by instrumentation engineers allow rapid simultaneous recording of data from many information points.

Frequent informal discussions among analytical engineers assure continuous exchange of ideas on related research projects.

Under the close supervision of an engineer, final adjustments are made on a rig for testing an advanced liquid metal system.

Engineers at Pratt & Whitney Aircraft today are concerned with the development of all forms of flight propulsion systems—air breathing, rocket, nuclear and other advanced types for propulsion in space. Many of these systems are so entirely new in concept that their design and development, and allied research programs, require technical personnel not previously associated with the development of aircraft engines. Where the company was once primarily interested in graduates with degrees in mechanical and aeronautical engineering, it now also requires men with degrees in electrical, chemical, and nuclear engineering, and in physics, chemistry, and metallurgy.

Included in a wide range of engineering activities open to technically trained graduates at all levels are these four basic fields:

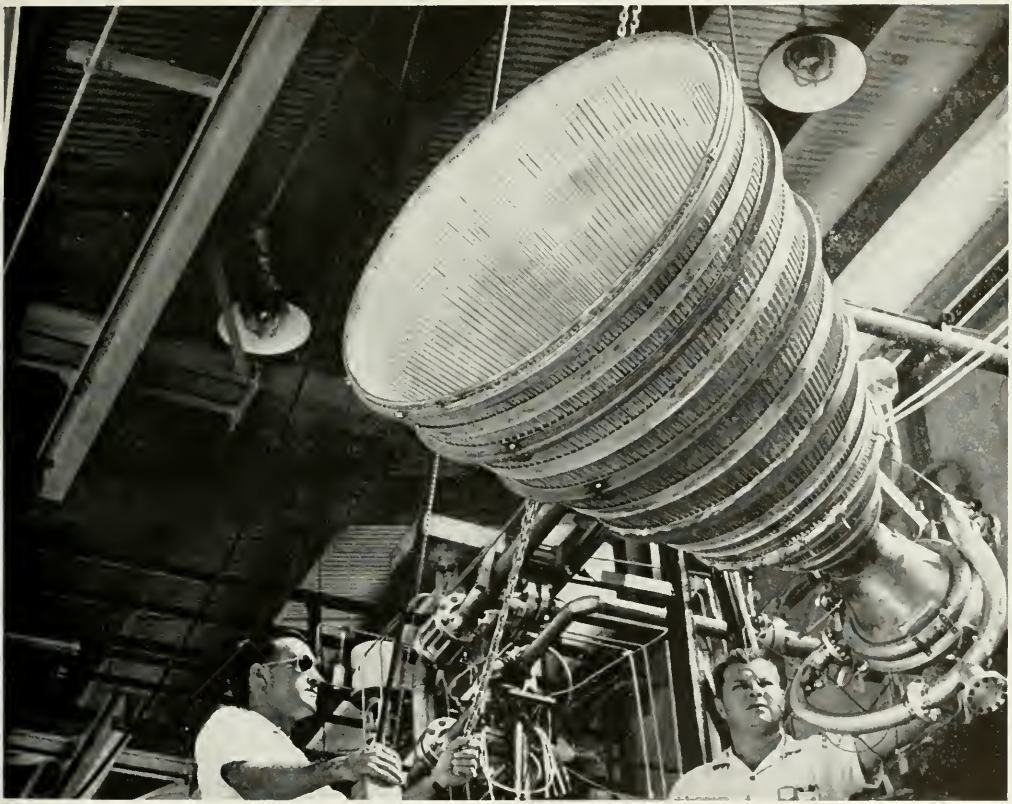
ANALYTICAL ENGINEERING Men engaged in this activity are concerned with fundamental investigations in the fields of science or engineering related to the conception of new products. They carry out detailed analyses of advanced flight and space systems and interpret results in terms of practical design applications. They provide basic information which is essential in determining the types of systems that have development potential.

DESIGN ENGINEERING The prime requisite here is an active interest in the application of aerodynamics, thermodynamics, stress analysis, and principles of machine design to the creation of new flight propulsion systems. Men engaged in this activity at P&WA establish the specific performance and structural requirements of the new product and design it as a complete working mechanism.

EXPERIMENTAL ENGINEERING Here men supervise and coordinate fabrication, assembly and laboratory testing of experimental apparatus, system components, and development engines. They devise test rigs and laboratory setups, specify instrumentation and direct execution of the actual test programs. Responsibility in this phase of the development program also includes analysis of test data, reporting of results and recommendations for future effort.

MATERIALS ENGINEERING Men active in this field at P&WA investigate metals, alloys and other materials under various environmental conditions to determine their usefulness as applied to advanced flight propulsion systems. They devise material testing methods and design special test equipment. They are also responsible for the determination of new fabrication techniques and causes of failures or manufacturing difficulties.

Pratt & Whitney Aircraft...



Exhaustive testing of full-scale rocket engine thrust chambers is carried on at the Florida Research and Development Center.

For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

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SOUSED *for* SCIENCE

RESEARCH INTO THE EFFECTS OF ALCOHOL

By Jerry Jewett

On September tenth, of this year, three men appearing for the Traffic Short Course given by the College of Law in connection with the University of Illinois Traffic Court Safety Conference consumed liquor in the interests of science to demonstrate graphically to the assembled officials the affects of alcohol on the driver.

These men, one a justice of the peace, forty-two year old Judge Robert Brown, another, L. James Strif, a former naval officer and present junior in the College of Law, and Harold Stainer, a big two-hundred pound reporter for the Decatur Review, sat down before the round of tests to enjoy a lunch of either a hamburger or ham sandwich with coffee or milk. *After this in less than fifty minutes*, the men drank the previously determined amount of liquor.

Judge Brown had nine shots of one-hundred proof bourbon mixed with coke, James Strif drank straight five ounces of one-hundred proof Old Grand Dad, and Harold Stainer consumed six cans of beer in the alloted time. Immediately following this, the men were put through a battery of tests given by Professor Borkenstein of the University of Indiana and State Trooper Walter Ziel. These tests had been administered once before the men began their drinking bout. The tests included a Breathalizer test to measure alcohol in the blood stream, the Canadian Dot test to measure concentration and reaction, a depth perception test, and a reaction test which measured reaction speed and errors in decision making.

The results of these tests showed that in ability to concentrate, Judge Brown and James Strif deteriorated at the same rate of fifteen per cent. Brown deteriorated one-hundred forty-seven per cent in depth perception; Strif, three-hundred eighty-five per cent; and Stainer, one-hundred eighty-nine per cent. In glare recovery Judge Brown went down one-hundred forty-five per cent; James Struif, eleven per cent; and Harold Stainer one-hundred eight-nine per cent. However in errors, Brown made one-hundred sixty per cent more after drinking; Struif, two-hundred seventy-five per cent more; and Stainer, one-hundred sixty-six per cent more.

These tests were designed as a demonstration to determine the efficiency of chemical tests, for it was hoped that this information would help the judges, justices of the peace, magistrates, and attorneys to detect people too drunk to drive.

In this state, a person must have over fifteen hundredths per cent alcohol or over fifteen parts of alcohol per ten thousand units of blood to be guilty of drunken driving. Between five and fifteen hundredths, a person may be arrested for drunken driving but conviction is hard unless further evidence is presented.

In addition to determining the efficiency of chemical tests, this experiment also showed that the light social drinker is more of a menace than the completely drunk individual. Someone with over fifteen hundredths per cent alcohol in his blood stream may actually be safer on the road than one less drunk. The completely inebriated person compensates for his drunkenness by going very slowly so that other drivers know he's coming. The person with fewer drinks feels he can do anything and travels at lethal speeds of seventy or eighty miles per hour. These people feel that they are driving better than they ever have before, but really many of their decisions may be incorrect even if their reaction time is just as fast. The test proved that the three guinea pigs could make decisions just as rapidly as before drinking, but their percentage of errors increased remarkably after the drinks. These men only had eight hundredths per cent of alcohol in their bloodstream; so although they were not legally presumed drunk, they would have been a menace on the highway.

Robert Stainer pointed out a few little-known fallacies and truths about drinking which the tests proved. For one thing, one shot of one-hundred proof whiskey equals in alcoholic content one twelve ounce can of beer, and a man weighing two hundred pounds can have two drinks for every one a

(Continued on Page 40)

SOUSED FOR SCIENCE . . .

(Continued from Page 38)

one hundred pound man has. Thus the alcohol rate in their blood stream will be kept even. The tests also proved that drinking a fifth of bourbon in over twenty-four hours will leave a person sober but consuming it in sixteen hours or less will make one drunk. Taking one drink an hour, a person's body burns the alcohol as fast as it is being absorbed, but taking two drinks an hour one is being burned up and the other is being stored. Eating before drinking will help somewhat because alcohol is absorbed into the blood more quickly on an empty stomach. That one last cup of coffee for the "road" will not help at all. Neither garlic nor onions will change the effectiveness of the Breathalizer test.

Between seventy to eighty per cent of the major traffic accidents involve at least one driver who has been drinking too much. It is felt that the social drinker, if he realized his potential deadliness, would be more careful about driving when he has been drinking. Even though over fifteen parts of alcohol per ten thousand units of blood indicate conclusively that a driver is drunk, a driver with less than this concentration of alcohol may be far more dangerous.

System for Safe Flying

A new instrument flying system enables a pilot to judge his altitude, ground speed and compass heading. The system, demonstrated on a helicopter, promises safe all-weather flying for airplanes and helicopters.

Fast Highway Painter

The Delaware State Highway Department uses an electronically controlled highway striping machine that can apply solid, broken or edge lines at speeds of 12-to-15 miles per hour. Built into a light truck chassis, the unit carries its own supplies of white and yellow marking paints and reflective glass beads, and can be applied by one man.

Brain Surgery Will Cut Food Bill

Medical researchers are looking for the part of the brain that controls the appetite. If they find it, a surgeon will be able to cut the food bill.

Hula Hoop Craze

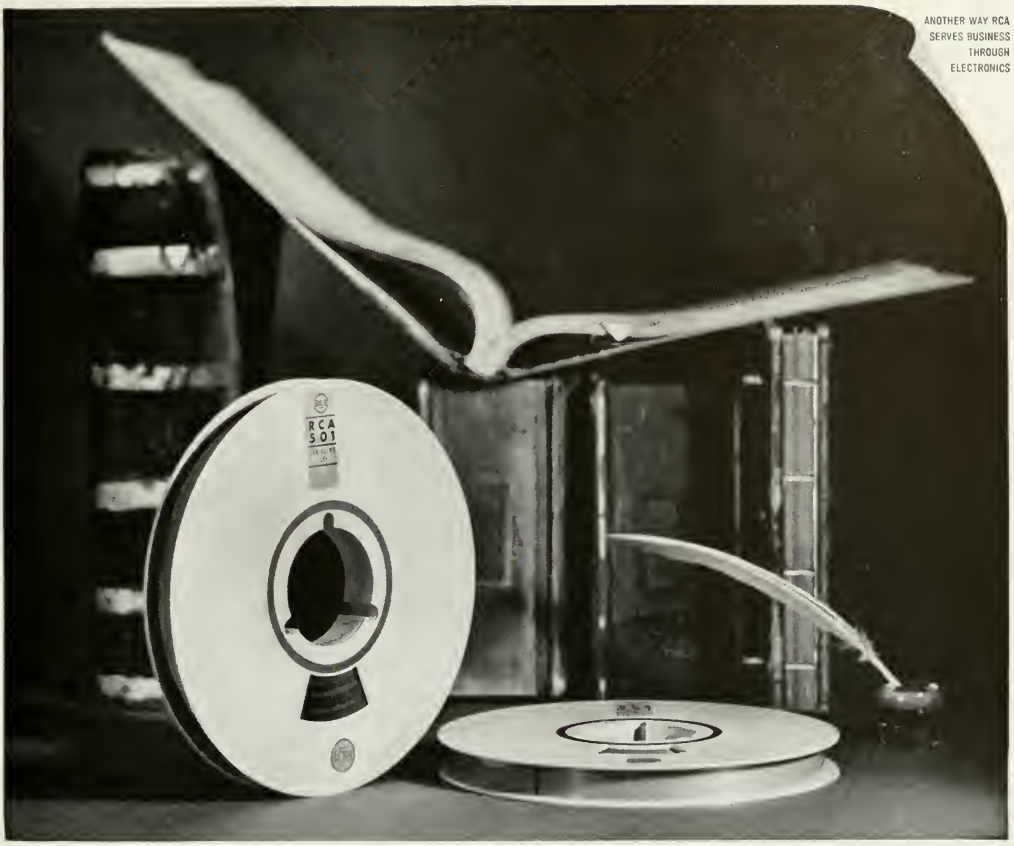
The current world-wide craze for hula hoops—which range in price from around sixty cents to a sophisticated mink-covered hoop for $100—has put hoop sales to around $35 million, reports Chemical Week.

Farm Equipment Industry Big Consumer of Iron

A comparatively new metal that bridges the gap between steel and ordinary cast iron, ductile iron gained a foothold in the farm equipment industry last year when about 12,000 tons were consumed. During the current year some 27,000 tons of ductile iron castings will be used in plows, listers, hay balers, cotton and corn pickers, harvesters, threshers, small tractors and other farm equipment. The farm equipment field is only one of many in which ductile iron has found widespread use.

The materials being replaced by ductile iron in a wide assortment of components include gray iron, pearlitic malleable iron and steel forgings and castings. Ductile iron castings are also being used in original designs which in the past would have been weldments for forgings.

Ductile iron is gaining the ascendancy over ordinary cast iron especially in the case of rotating parts. With farm machinery being designed to handle ever heavier duties at continually increasing speeds, greater strength and ductility than that offered by gray irons are required. The need for a stronger material at a price much lower than other engineering materials of similar strength is being met by ductile iron.



RCA Electronics creates the "501" to streamline the paper work of business—it reads, writes, figures and remembers on tape

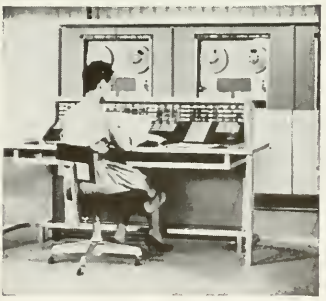
Much of today's traffic jam in paper work is being eliminated by electronic data processing. But to build a system that would be practical and economical for even medium-sized organizations was a job for electronic specialists.

To solve the problem, RCA drew on its broad experience in building computers for military applications and combed its many laboratories for the latest electronic advances that could help. The result was the RCA "501" high-speed electronic data processing system—the most compact, flexible, and economical ever built. It is a pioneer system with all-transistor construction for business use.

The "501" cuts out paper work bottlenecks for many government agencies and businesses, from stock brokerage firms to public utilities, banks, insurance companies, and steel mills.

It "remembers" millions of letters, numbers, and symbols that are "read" onto its magnetic tapes by such things as punch cards and paper tapes. In a fraction of a second, it can do thousands of calculating, sorting, and comparing operations—and checks each step. Finally, it writes such things as bills, reports, payrolls in plain English at 72,000 characters per minute.

This economical and practical answer to an acute business problem is another way RCA Electronics is helping to simplify the growing complexity of business.



RADIO CORPORATION OF AMERICA

Technograph Launches Satellite . . .

(Continued from Page 29)

Two minutes later, the countdown had recycled and was again in the final ten seconds. "3, 2, 1, Zero!"

A burst of blue-white flame shot out from the base of the rocket. As the rocket built up thrust, it remained locked tight to the pad by the special restraining arms. When the project boss was satisfied that the engine was working properly, he ordered, "Let her go!"

The restraining arms snapped back from the rocket, and with a tremendous roar the vehicle lifted slowly off the pad and climbed upward. The glare of the exhaust was so intense that it lit up the surrounding countryside like daylight, much to the dismay of numerous co-eds.

The rocket gained speed and altitude quite rapidly and began to tilt toward the north. At this time a group of student members of the Chicago Rocket Society were alerted to watch for the vehicle as it passed over Chicago. At X + 167 seconds the rocket vehicle was travelling horizontally with a velocity of some 10,000 mph, 105 miles above Harvey, Illinois. At this instant, the first stage burned out and the second stage took over, boosting itself and the catellite to orbital velocity of 18,000 mph.

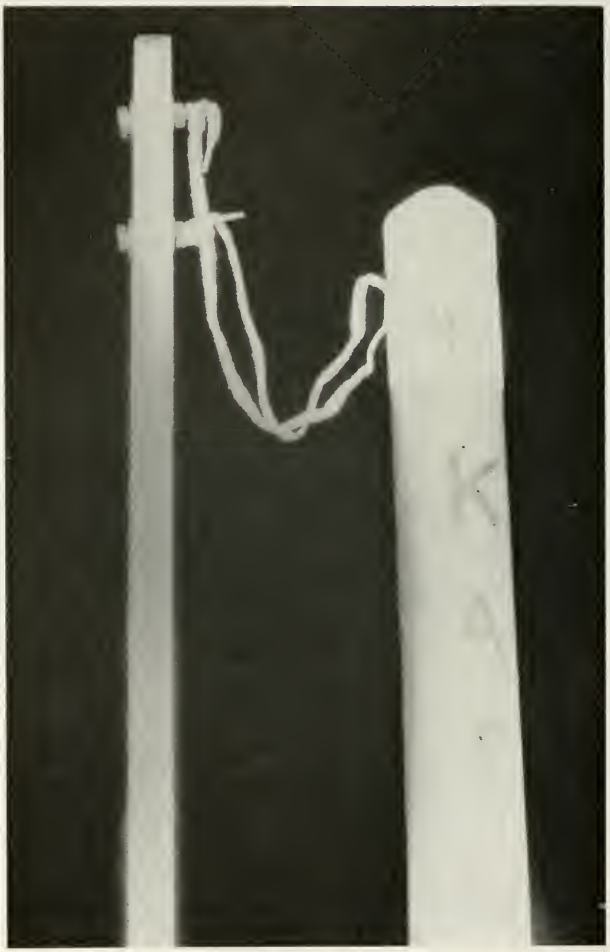
The catellite then separated from the second stage and both were in orbit.

The second stage firing was clearly visible from to the naked eye; the exhaust flame appeared brighter than Venus.

At first the crew worried that the catellite might not orbit because the perigee was only 105 miles instead of the planned 120 miles, but they soon forgot their worries.

In the meantime, the first stage which had separated from the second just south of Chicago, was beginning its re-entry trajectory. It had been planned that the first stage would re-enter over Lake Superior, 600 miles north of the University. However, because of the somewhat low perigee (caused by a malfunction in the guidance system) the first stage landed in the outskirts of the town of Cascade, Michigan, just iland from the shore of Lake Superior.

The flaming rocket smashed into a highway about thirty feet from a parked whisky truck. The impact set off a detonation of the highly explosive liquids stored in the truck. This spread to similar supplies of explosives in a tavern nearby. The truck driver and tavern owner stopped sampling supplies and headed for a bomb shelter



X minus 10 seconds . . . Katnik I just before launching. Frost on the missile is due to the sub-zero liquid, HOOCH, stored inside.

when they saw the burning rocket approaching them. They figured the spirits were out to get them and ran in fright.

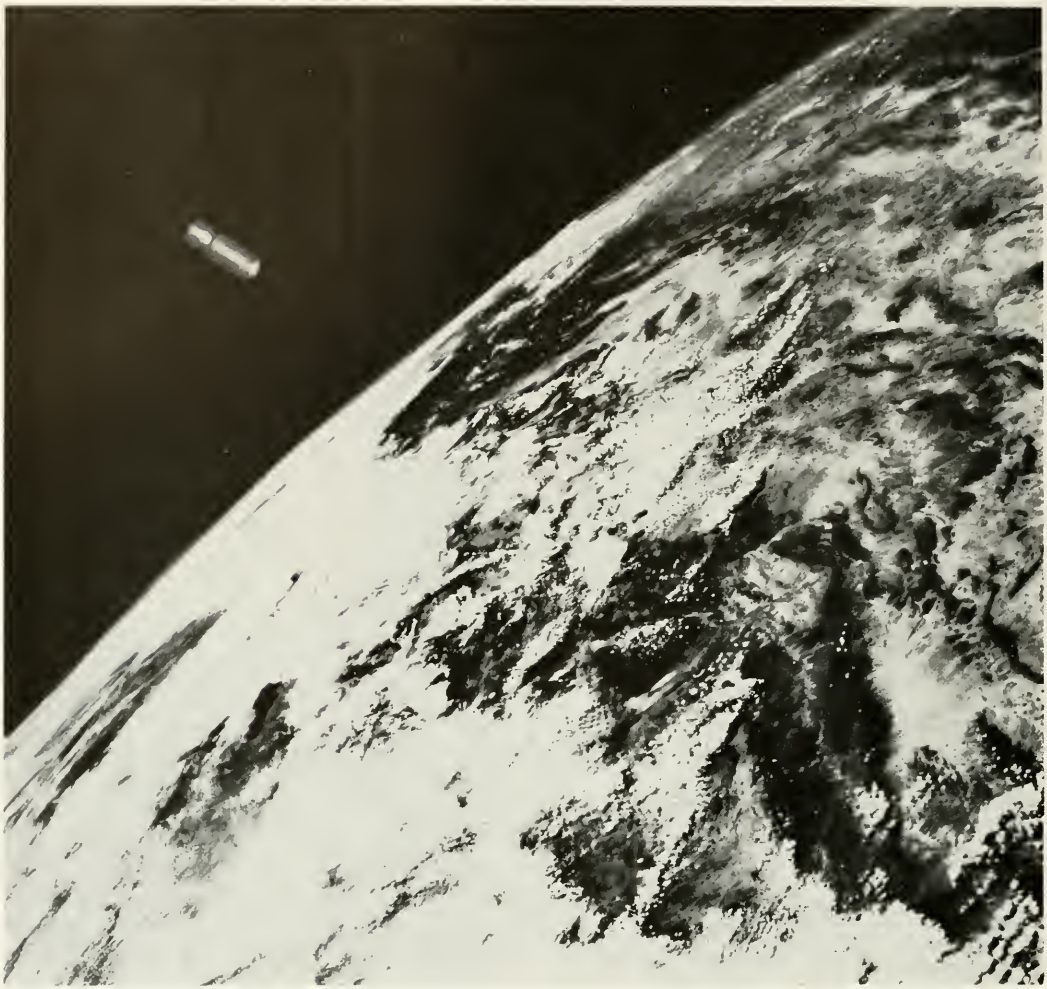
About one-half hour after this, signals of the satellite passing west of the University came in. The rocket was on orbit.

As data poured in, the men at the launching site grew wilder and wilder. Although the satellite perigee was only 105 miles, the apogee was over 970 far exceeding expectations.

It seemed there would be little celebration at the launch site (the traditional type) because it was 5:20 a.m. and all coffee shops were closed; but the chemical engineers came through again, serving the first stage fuel as "Scotch on the rockets."

By the next night, the orbit of the satellite had begun to decay as had the crew. Tracking stations and rescue ships were alterted to retrieve the catellite when it re-entered the atmosphere. The orbit of th satellite had been accurately determined although attempts to use the 12-inch telescope met with

Katnik blasts off on historic flight to place world's first cat-carrying space vehicle into orbit



Above: One of the few existing photos of the catellite in orbit. Seen in the background is the moon.

difficulty. A bald eagle had built its nest on the main lens.

On the 16th orbit, the second stage re-entered the atmosphere south of Los Angeles. As it reached the city limits, it caught fire and fell into the set of a new Hollywood movie, "The Return of Jesse James." The producer and director of the film plan to incorporate the unscheduled scene into the movie by a slight revision of the script.

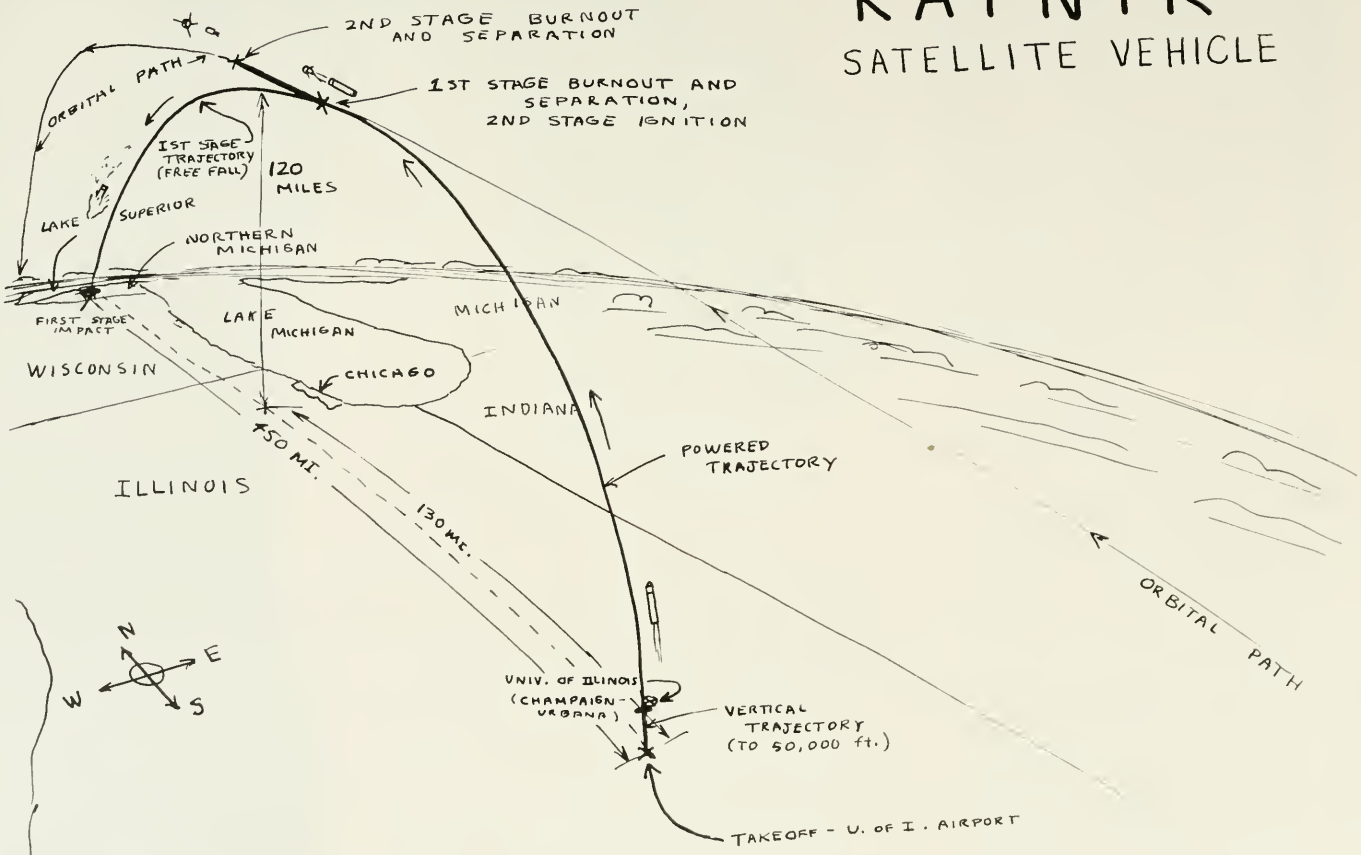
The catellite re-entered the atmosphere just off the Aleutian Islands on the next orbit. Rescue ships were alerted, and the cat and vehicle were recovered intact the next day. When the chamber was unlocked, it appeared that the cat had been reduced in size. One of the ship's crew pointed out that the cat had merely given birth to a kitten. (He was a family man, himself).

The cats are now being studied by the biology department to determine the effect of radiation, prolonged weightlessness and the affects of outer space on litter size.

All University departments were pleased with the success of the flight with one exception. The University Security Division charged the Tehnograph office with violating the fireworks statute. The staff members didn't sweat it; one of their former editors who now is a janitor in the Pentagon, was able to have the charges dismissed.

As for the future, another rocket similar to this one will be orbited about the Moon. It is to be noted, however, that there will be no mice on the flight since the Russians have discredited the cheese theory. (Besides, Flunkout II, has top priority.)

FLIGHT PATH PLAN
"KATNIK"
SATELLITE VEHICLE



HUGHES MASTERS FELLOWSHIPS. The Hughes Masters Fellowship Program offers unusual opportunities for academic training leading to a master's degree . . . and, in addition, provides each fellow with practical experience in the professional field of his choice.

Approximately one hundred new awards will be made by Hughes in 1960 to qualified applicants who possess a bachelor's degree in science or engineering. Additional awards are open to qualified applicants interested in business administration and education.

Hughes conducts extensive research and development in the scientific and engineering fields. While working for Hughes, fellows may be assigned to such areas of Research & Development as: microwave devices, parametric amplifiers, masers, infrared search and track systems, microminiaturization, antenna arrays, simulation methods, propagation, data handling, human factor analysis——and to a variety of engineering areas such as guided missiles, weapons control systems and systems analysis.

A selected group of award winners will be offered a **FULL STUDY PROGRAM.** Participants in this program will receive fellowships th permit them to attend an outstanding university on a full time bas during the regular academic year with a substantial stipend.

Other award winners will be assigned to the **WORK STUDY PROGRA** and will attend a university sufficiently near a facility of the Hugh Aircraft Company to permit them to obtain practical experience, a professional field of their choice, by working at the company pa time each week. An appropriate stipend will also be awarded.

After completion of the Master's Program, fellows are eligible to apr for HUGHES STAFF DOCTORAL FELLOWSHIPS.

The classified nature of work at Hughes makes eligibility for securi clearance a requirement.

Closing date for applications: January 15, 1960.

How to apply: Write Dr. C. N. Warfield, Scientific Education, Hugh Aircraft Company, Culver City, California.

Hughes Fellowship Programs

HWARD HUGHES DOCTORAL FELLOWSHIPS. If you are inter- e ed in studies leading to a doctor's degree in physics or engineering, y u are invited to apply for one of approximately 10 new awards in the 1 50 Howard Hughes Doctoral Fellowship Program.

T s unique program offers the doctoral candidate the optimum c nbination of high-level study at an outstanding institution plus p ctical industrial experience in the Hughes laboratories.

E h Howard Hughes Doctoral Fellowship provides approximately $,000 annually. Of this amount $1,800 is for tuition, books, fees, t sis and research expenses. The remainder is the award of a cash s pend and salary earned by the fellow.

lughes conducts extensive research and development in the scientific d engineering fields. Typical programs include: network analysis d synthesis, semiconductor materials, plasma electronics, commu- c ations, computing . . . and solid state physics, atomic and nuclear ysics, tests of the general theory of relativity, chemistry, physical emistry and metallurgy, information theory, mechanics of struc- tures, electro-mechanical propulsion systems, and systems analysis.

Howard Hughes Doctoral Fellowships are open to outstanding students qualified for admission to graduate standing. A master's degree, or equivalent graduate work, is considered very desirable before beginning the Fellowship Program.

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Closing date for applications: January 15, 1960.

How to apply: Write Dr. C. N. Warfield, Scientific Education, Hughes Aircraft Company, Culver City, California.

Creating a new world with ELECTRONICS

HUGHES


BFP

TEACHING INTERNES

By Bill Andrews

Quietly getting under way this semester here at the University of Illinois is a new intern program for prospective engineering teachers. This program is being carried out in the departments of Mechanical and Electrical Engineering under the sponsorship of the Ford Foundation. The pilot program will, over a period of four years, involve a total of thirty graduate engineering students, each of whom will participate for four semesters. Each fall, beginning this fall, there are to be ten students starting the program, five from the Department of Electrical Engineering and five from the Deparment of Mechanical Engineering. (This fall, because one of the accepted applicants dropped out of the program too late to be replaced, there are only nine. Next year there will be eleven starting the program.) In the course of each intern's two years he will work toward his Master of Science Degree, which he will obtain after three or four semesters, in the former case continuing work toward his doctorate in the final semester of his participation in the program. In addition to a half to two-thirds academic load, the graduate students are involved in two other phases of this program designed to prepare him for a teaching career. He gains teaching experience through a phase in teaching plan which softens the transition from student to teacher. He also actively participates in a series of seminars on a wide variety of subjects. Each student receives an annual stipend of $2,000 to defray the cost of living at the University.

This program was envisioned about two and a half years ago as a reply to a problem posed by the provost of the University of Illinois, Gordon N. Ray: How is your department going to insure an adequate supply of instructors for the anticipated increase in enrollment? This was passed by Dean William L. Everitt of the College of Engineering to Professor Seicho Konzo, Chairman of the College's Graduate Committee. The ideas worked out by Professor Konzo are essentially the program now under way. It was decided to submit the plan to the Ford Foundation, which had shown recently an interest in the problems of engineering education. They suggested a few minor changes in the plan, such as including students in only two departments rather than throughout the college of engineering, and then approved the program. All this took only about six months. However, it was still too late to get started the fall, 1958, semester, so it was begun this fall.

The selection of the interns began last year with the notification of the various colleges of engineering across the country of the program. By the closing date for applications, February, 1959, the College had seventy-five applications for the ten available positions. The successful applicants were notified in March and reported here to begin this September. Among the considerations in selecting the candidates were scholarship (A "B" average or standing in the top twenty per cent of his graduating class was required to be considered.), three letters of reference from engineering instructors, and a real interest in the engineering teaching profession. An attempt was also made to distribute the scholarships so that a large number of schools would be represented. (The nine men presently enrolled in the program represent eight universities, with only the University of Alberta represented twice.) Although the program is primarily intended for those just receiving their B.S. degree, consideration is also given recent graduates now serving in industry or teaching.

It should be noted that the University of Illinois does not stand to gain from this program directly in terms of available teachers. This is because of a clause in the program that none of the men completing the program will be offered positions at the University of Illinois for a period of five years, and then only upon application by the student. The purpose of this program is not to augment the teacher supply for the host school.

The graduate work done by the students is not appreciably affected by the nature of the program. The foreign language requirements of the Ph.D. are anticipated by the students and courses taken to meet them. Other than these, most of the courses taken are advanced engineering courses. This phase of the program occupies approximately three-fifths of the student's time, the remainder divided between the two unique phases of the program.

The teaching intern concept of the program is one of the real innovations. Here the student first learns teaching from observing outstanding instructor experts, grading papers, working with laboratory groups, and finally, in their final semester in the program, taking over an actual class, giving it with a minimum of supervision from the college staff. Each student is assigned an instructor as his advisor. This instructor has been chosen by the department for his particular teaching abilities. Thus avoiding the shock of being handed a book and being told he has sixteen weeks to cover this material, which is rather discouraging to a prospective teacher, the intern is phased into actual teaching in gradual steps. In some cases it is felt that the student is qualified to go directly into laboratory work, so

that a number of students are now, in their first semester in the program, actually working with lab sections.

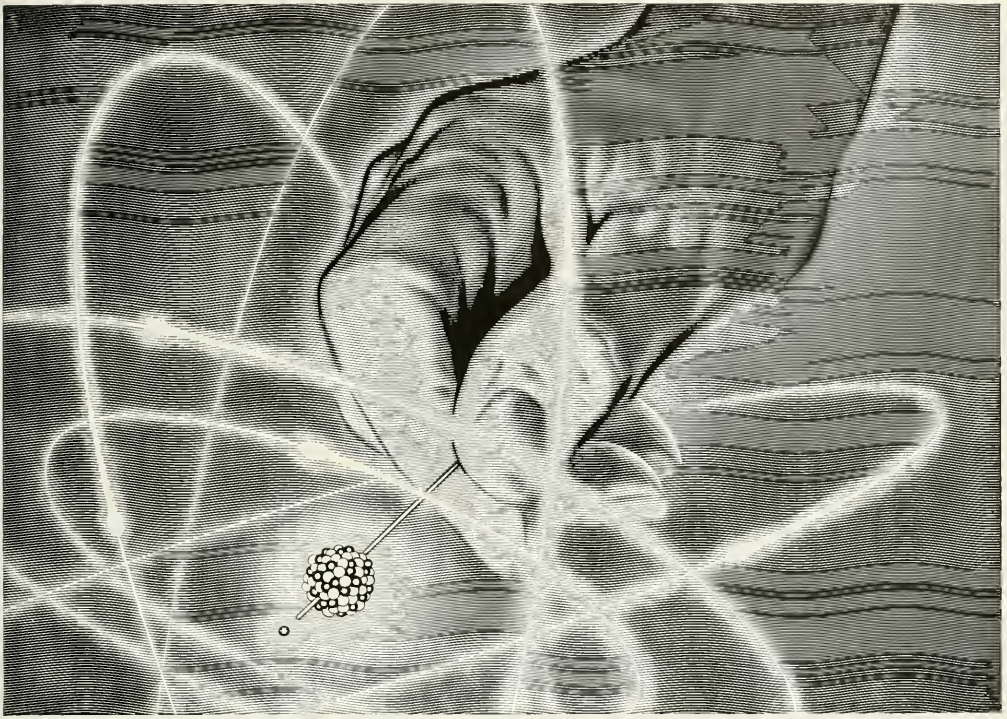
The final phase of the course is a series of weekly two hour seminars. These will require a certain amount of outside reading on the part of the interns in preparation, and a great deal on the part of the particular intern who is conducting each. The variety of subjects projected suggests the variety of purposes indulging them. Some are highly practical in teaching the students certain subject material, classroom psychology, and information about testing methods. Others will be of more broadening value. These will cover such diverse subjects as jazz, sociological problems, and fine arts. In addition to the actual information which is available through these seminars, the students get invaluable experience in group dynamics and general class handling. Each of the students will be chairman of one or more of these seminars and, at other times, recorder-reporter, who must prepare a summary of the proceedings. He gets opportunities to observe how individuals are "drawn in" to the discussion and how to think on his feet.

Preparing for teaching through this pilot program are nine men with only a desire to teach engineering in common. They come from Canada and Oklahoma, Kansas and the Bronx, up-state New York and suburban Chicago. One thirty-five year old intern is the father of three while another is twenty-one. Their interests run from Thermodynamics to Microwave Communications. Of the nine, five are ME's, three EE's, and one, Gordon Anderson, has transferred to the department of physics and is working under the program in this department.

It is the hope of the department that this program will prove itself worthy of its expectations and eventually spread to other universities. The shortage of engineering instructors is particularly serious in the smaller engineering schools where there are relatively few graduate students who can handle classes themselves, and who are likely to stick with their alma mater as a teacher. It is thus a responsibility, the bigger of engineering colleges to help meet this demand.

Perhaps an indication of the students' impressions of the program thus far can be drawn from the opinion of Ed Yellin:

"The projected program, and the manner in which it has thus far been implemented, certainly indicate that those of us in the program will be both psychologically and educationally prepared to enter the engineering teaching profession."



. . . a hand in things to come

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UNION CARBIDE

...a hand in things to come

Magnetic Pump for Reactor Produced

The world's largest permanent magnet is scheduled to work in America's Atomic Energy Program. It will help pump liquid sodium in a breeder reactor to be operated by the Argonne National Laboratory for the Atomic Energy Commission. To be known as the Experimental Breeder Reactor \$\$ (EBR-II), this reactor will produce electrical power on the Argonne Idaho Division site at the National Reactor Testing Station near Idaho Falls, Idaho.

The magnet weighs 1720 pounds, and is made of Alnico V material. The overall dimensions of the magnet are 52½ by 36 by 10 inches. It has a gap length of 16½ inches and a gap volume of 1584 cubic inches.

The magnet was checked in a 3000 hour test at temperatures up to 750 degrees F prior to its being put into service at the Argonne National Laboratory.

The huge permanent magnet will help in the pumping of the highly radioactive sodium at elevated temperatures.

The pumps operate without moving parts. This is achieved by the interaction between a current passing through the sodium at right angles to a strong magnetic field. This interaction produces a force in the sodium when directed through a closed piping system serving as a continuous supply of liquid sodium.

STATEMENT REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION

Of The Illinois Technograph published October, November, December, January, February, March, April and May, at Urbana, Illinois for October 1, 1959

1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Illini Publishing Company, 620 E. John St., Champaign, Illinois;

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Business Manager, Roger Harrison, 215 Civil Engineering Hall, Urbana, Illinois.

2. The owner is: the Illini Publishing Company, a non-profit corporation.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: none.

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Roger L. Harrison, Business Manager.

Sworn to and subscribed before me this 10th day of October, 1959.

(SEAL) H. E. York.

(My commission expires Dec. 30, 1963)

Raytheon Graduate Program

FOR STUDY AT HARVARD MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND CALIFORNIA INSTITUTE OF TECHNOLOGY IN 1960-61

HARVARD

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

CALIFORNIA INSTITUTE OF TECHNOLOGY

The Raytheon Graduate Program has been established to contribute to the technical development of scientists and engineers at Raytheon. It provides the opportunity to selected persons employed by Raytheon, who are accepted as graduate students by Harvard University, Massachusetts Institute of Technology and California Institute of Technology, to pursue at Raytheon's expense, regular courses of study leading to a master's or doctor's degree in science or engineering in the institution of their choice.

The Program requires, in general, two or three semesters of study, depending on circumstances, with the summer months spent in the Company's research, engineering, or manufacturing divisions. It includes full tuition, fees, book allowances and a salary while at school. Students are eligible for health, accident, retirement and life insurance benefits, annual vacation and other privileges of full-time Raytheon employees.

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Engineering Employment Supervisor
P.O. Box 516, St. Louis 66, Missouri

Monitoring a thermal-stress test in the Transient Heat Facility are Project Mercury staff members, True E. Cousins, BSAE, U. of Kansas, '58, on the left, and Eugene G. Shifrin, BSME, U. of Iowa, '55.

McDONNELL Aircraft

The Campus at Night . . .

WHAT THE CAMPUS LOOKS LIKE

AFTER THE SHADES ARE DRAWN

AND THE CAT PUT OUT

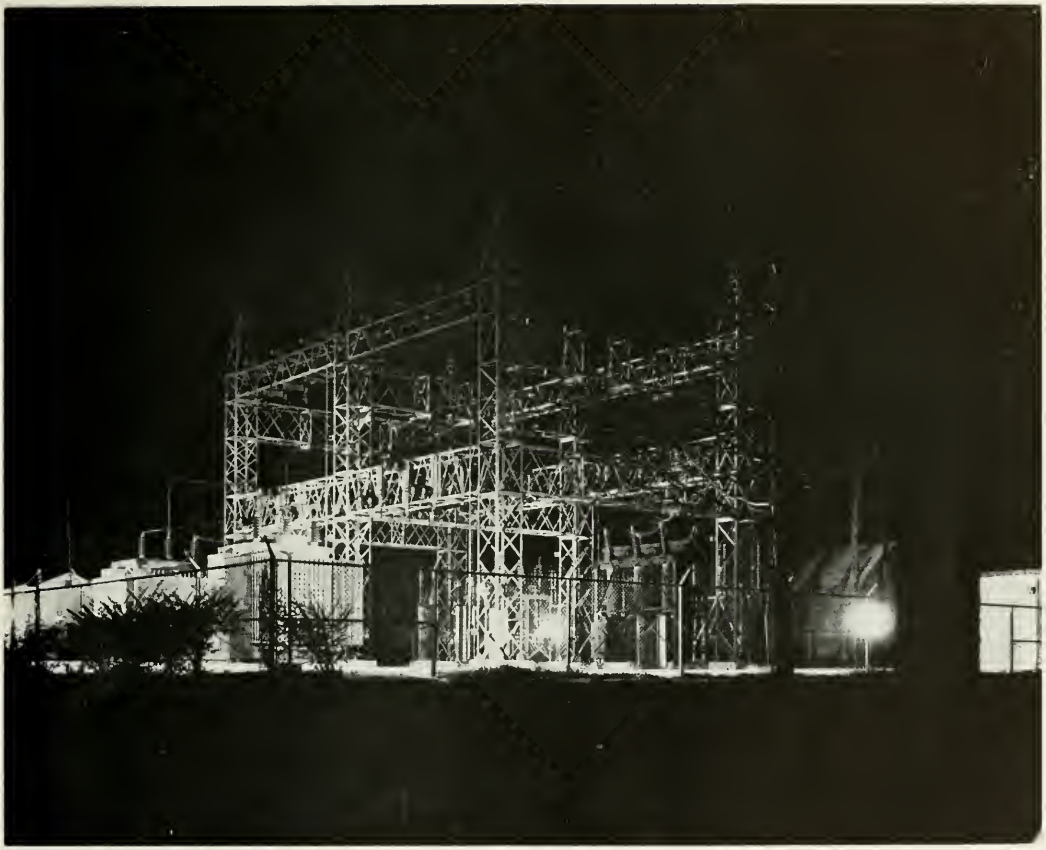
LOOK FAMILIAR?

AT LAST!

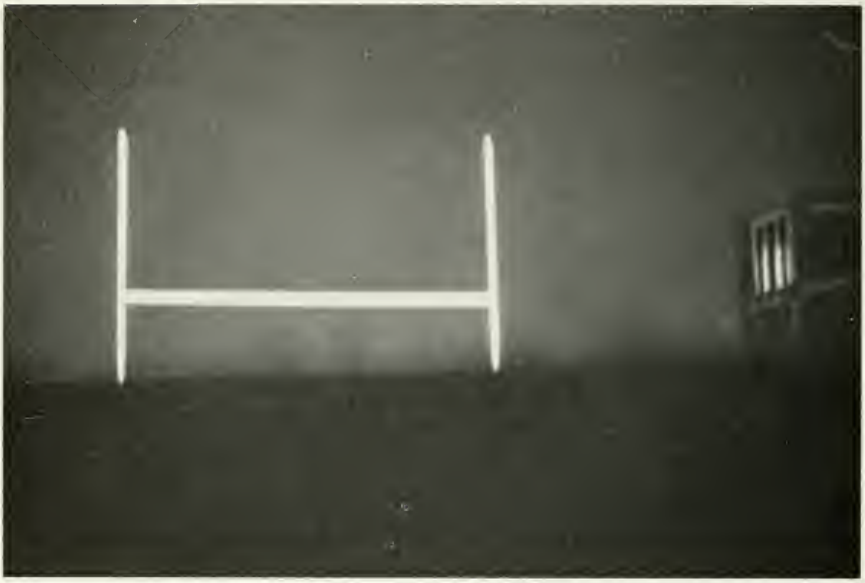
MIDNIGHT GRIND AT MRH

AND AT BEVIER HALL

POWER PLANT (M.E. 263 PROVING GROUND)

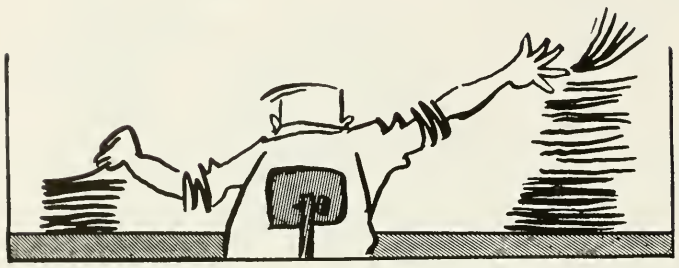


E.E. COMES THROUGH!



LATE FOR THE GAME

Skimming Industrial Headlines



Edited by Paul Cliff

Sputtered Resistors Make High Component Density Possible

Sputtered thin-film resistors, formed from refractory metals such as tantalum and titanium, may be one of the more important developments in microminiature electronics. Such resistors can be produced on glass or ceramic bases in lines as narrow as 1 mil (0.001 inch), spaced 1 mil apart, thus producing extremely high resistance in a small area.

Research in sputtering, an old technique in which ionized gas molecules bombard a cathode, dislodging atoms of metal which then redeposit on nearby surfaces, has been conducted at Bell Laboratories for several years.

The newly announced miniature resistors owe their success to a high precision masking process, which makes it possible to produce the thin films in specifically restricted locations. An expendable copper mask is used for this operation.

In producing a resistor, an over-all thin film of copper is first deposited onto the ceramic or glass base, for example, by sputtering. Then, the desired pattern is etched into the copper surface by standard photoetching techniques, leaving the bare substrate exposed. Tantalum, other refractory metals, or electrically useful alloys are then deposited onto the etched copper pattern, and the whole unit placed in an etching bath. The copper with its overlay of tantalum is removed, leaving behind only the tantalum which was in direct contact with the bare surface. Since the masks are extremely thin, fine detail is possible. Also, since the sputtered materials adhere to the substrate itself, support considerations are not necessary and complex patterns can be produced.

"Goer"—New Military Transporter

A new type of off-road transport vehicle, capable of delivering military supplies across-country to widely dispersed, fast moving units of the atomic age Army, is being manufactured by Le Tourneau - Westinghouse.

The giant rubber tired machine, dubbed the "Goer" for its "go-anywhere" mobility, is a strict departure from conventional Army trucks and transporters. Instead of following the historic pattern of being a military development which might one day be adapted to civilian use, it is essentially a "plowshare hammered into a sword." For the most part, Goer design principles and components have been adapted from those which have given mobility, agility and durability to commercial earthmoving machines in the United States since before World War II. The Goer's two-wheel prime mover; articulated, wagon-type electric steering; high ground clearance; springless suspension, rugged, simple power train; and six foot-tall rubber tires are all common to modern earthmoving equipment.

Two Goer prototypes—a 5,000-gallon fuel tanker and 15-ton cargo carrier negotiated a series of rugged rough-terrain problems which proved impossible for a fleet of conventional Army trucks and transporters. Fully loaded, the Goers climbed slopes, threaded their way between boulders, scaled a vertical wall, skimmed over a sand trap, snaked their way through whip-deep mud pits and topped the whole performance off by swimming across an inland lake.

New Copper Paste for Screen Printing

A new method for producing printed wiring directly on ceramic basis without the use of adhesives has recently been developed by Bell Telephone Laboratories. The basis of the new process, which uses standard silk screening techniques for forming the pattern, is a specially formulated copper-bearing paste. Following the printing of the desired pattern on the ceramic base, the piece is fired in a two-step process, resulting in a clean, durable pattern with excellent electrical characteristics.

In present methods of production, a sheet of copper foil is usually bonded to the ceramic or plastic base with an adhesive. The desired pattern is then produced by one of several methods usually involving the removal of undesired material. The bond of the copper to the base thus is dependent on the strength of the adhesive. Often, it fails during subsequent processing operations, such as soldering or assembly.

With the new process, a paste is prepared from a finely ground mixture of copper oxide and a special glass frit, blended with a standard silk screen printing vehicle. The paste is used to print the pattern on the ceramic, and the "card" is heat-dried to remove solvents. After drying, the card with its pattern is fired in air at 750°C for twenty minutes to burn off the printing vehicle. This operation leaves a non-conducting copper oxide pattern, ready to be reduced to metallic copper.

The second firing operation is conducted at 850°C for thirty minutes, in a controlled atmosphere containing hydrogen, nitrogen, and oxygen. The hydrogen in the atmosphere reduces the copper oxides to metallic copper, while the oxygen prevents reduction of other oxides in the system and promotes good wetting of the glass frit and the ceramic. Without the oxygen present, a poor bond results.

Rechargeable Nickel-Cadmium Batteries

A versatile selection of compact, rechargeable, sealed nickel-cadmium cells and batteries designed for battery-operated devices requiring high energy has been introduced by Burgess Battery Company.

The hermetically sealed construction of the new units, eliminating routine maintenance and the addition of liquids required by earlier nickel-cadmium bat-

teries, represents a major advance in secondary battery technology.

Burgess will market individual cells in eight sizes, as well as a range of multiple cell batteries in numerous voltages. The individual cells, rated at 1.25 volts, include six button-type units ranging from a finger-tip sized cell only four-tenths of an inch in diameter to one slightly larger than a silver dollar. Long-lasting single-cell batteries in penlight (AA) and standard flashlight battery (D) sizes also are available.

A virtually unlimited variety of multiple cell nickel-cadmium batteries could be designed from the cells to fill the widely varying requirements of industrial product designers and electronic engineers.

Development of a unique conductive silver wax inter-cell connection makes possible broad flexibility for nickel-cadmium battery designs. A dab of silver wax on the positive and negative sides of each cell permits cells to be connected in series merely by being stacked in a column. The ability of the wax to mold itself to any contour between the cells assures a permanent inter-cell connection which will not break even under rugged handling.

Recharging will restore the new nickel-cadmium batteries to peak operating efficiency hundreds of times. Response of the cells is equally good to either a slow or fast charge. The nickel-cadmium batteries are not affected adversely by long idle periods either in a charged or discharged state, and they operate in a temperature range of 0 to 115 degrees F.

In tests, engineers have demonstrated how the normal life of nickel-cadmium batteries can be extended many times by recharging before they discharge more than one-half of their capacity.

Winners of Highway Bridge Design Announced

Award winners of the $44,000 Steel Highway Bridge Design Competition sponsored by U. S. Steel's American Bridge Division were named.

Top winner in the professional classification was Allan M. Beesing, structural design engineer with James J. MacDonald, Buffalo, N. Y., consulting engineer. He was awarded $15,000 for his entry.

First award in the student classification went to a joint entry submitted by Niels Gimsing and Hans Nyvold of Copenhagen, Denmark. Both men were students at the Technical University of Denmark. They will share $4,000 for their entry.

The competition, conducted under the auspices of the American Institute of Steel Construction, Inc., required entrants to design a steel bridge to carry a two-lane crossroad over a modern four-lane highway. It was open to professional design engineers and college engineering students anywhere in the world.

Winning entries were selected on the basis of originality of design, utilization of the properties of steel, economy, and appearance.

According to A. J. Paddock, president of American Bridge Division, the selection of the particular problem featured in the competition is especially appropriate to the construction of America's 41,000-mile interstate and defense highway system over the next 15 years. It is estimated that more than one bridge will be required for each mile of the high speed highway network.

Beesing's top-award design is a graceful welded steel girder structure which bridges, in a single span, a four-lane divided highway. The skillful combination of carbon and high strength steels and design innovations permits the abutments to be moved back from the shoulders and eliminates the need for a center pier.

The Gimsing-Nyvold entry is a welded two-span frame bridge designed for mass production and requiring minimum field erection. Construction work is reduced to a few riveted or bolted connections.

Four of the 15 awards were made to foreign entries. Two went to student entries, the other two being awarded to professional entries.

w It as the consensus of the judges after completing their work that the professional entries were outstanding and indicated that they represented a lot of thought and effort. As for the student entries, they commented: "future of bridge design is in good hands." They were surprised and delighted at the quality of work turned in by students, one saying, "This is better than I could have done in my college days, which means better students today and speaks well of educational advances."

Compact Cathode Ray Tube Produced

The development of a newly designed, compact "Wamoscope"—a cathode ray tube capable of presenting microwave frequency information directly on its screen—was announced by Sylvania Electric Products Inc.

Dr. Robert M. Bowie, vice president Sylvania Research Laboratories, said the new tube, which was developed for use in advanced electronic systems applications, does not require a solenoid, a bulky focusing structure requiring an external source of electric current. The "Wamoscope" is only slightly longer than conventional television picture tubes.

The improved "Wamoscope" operates over a frequency range of 2 to 10 kmc, and will be particularly important in high-resolution ralar applications, Dr. Bowie said. The new tube has a signal coupler incorporated within the tube envelope and "spot size" has been improved to 160 lines per inch at the center of its 10-inch screen.

Stainless Steel Pump for Yankee Atomic Electric Plant

Shown at Westinghouse Electric Corporation's atomic equipment department, a 16,000-pound canned motor pufmp volute is being made for the Yankee Atomic Electric Company's 134,000-kilowatt nuclear power plant at Rowe, Mass. The finished canned

motor pump, which will be hermetically sealed, will be over 11 feet high and will weigh 39,000 pounds. Along with three other units, the canned motor pump, rated at 1600 horsepower, will circulate radioactive water at 496 degrees F through the nuclear reactor system at a rate of 23,700 gallons per minute at a system pressure of about 2000 pounds per square inch. There will be an 80-psi pressure rise across the pump. Both the rotor, or rotating part, and stator, or stationary part, of this type of pump are encased, or "canned," in metal. Water being circulated flows through the space between the rotor and the stator, thus acting as a coolant and lubricant.

Skin-Diver Patrol

Skin divers patrol submarine cables of an electric utility company. The divers are able to check the cables at a rate up to two miles per day in depths up to 40 feet and one-half mile per day in deeper water, where decompression is required after 35 minutes' exposure.

Could this be a picture of you tomorrow? In the fall of 1958, it was Jack Carroll, principal speaker at the opening of Electronic Associates' modern new plant in Long Branch, N. J.

Jack Carroll (*right*) discusses the new equipment he has just seen during a visit with Henri Busignies, President of ITT Laboratories (*center*) and Anthony Pregliese, ITT Public Relations.

Cash Prizes!

FOR

BRAINTEASERS

The TECHNOGRAPH will award $5 to each of the winners of the monthly brainteaser contests which will begin with this issue. The winner will be the person who turns in the greatest number of correct answers to the TECHNOGRAPH office in 215 Civil Engineering Hall. If there is a tie, the prize will be given to the entry with the earliest date. The deadline for entries this month is December 10th.

BRAIN TEASERS

Edited by Steve Dilts

A group of airplanes is based on a small island. The tank of each plane holds just enough fuel to take it halfway around the world. Any desired amount of fuel can be transferred from the tank of one plane to the tank of another while the planes are in flight. The only source of fuel is on the island, and for the purposes of the problem it is assumed that there is no time lost in refueling either in the air or on the ground. What is the smallest number of planes that will insure the flight of one plane around the world on a great circle, assuming that the planes have the same constant ground speed and rate of fuel consumption and that all planes return safely to their island base?

* * *

What is the radius of the largest circle that can be drawn entirely on the black squares of a chessboard with squares that are two inches on a side?

* * *

An amusing parlor trick is performed as follows. Ask spectator A to jot down any three-digit number, and then to repeat the digits in the same order to make a six-digit number (*e.g.*, 394,394). With your back turned so that you cannot see the number, ask A to pass the sheet of paper to spectator B, who is requested to divide the number by 7.

"Don't worry about the remainder," you tell him, "because there won't be any." B is surprised to discover that you are right (*e.g.*, 394,394 divided by 7 is 56,342). Without telling you the result he passes it on to spectator C, who is told to divide it by 11. Once again you state that there will be no remainder, and this also proves correct (56,342 divided by 11 is 5,122).

With your back still turned, and no knowledge whatever of the figures obtained by these computations, you direct a fourth spectator, D, to divide the last result by 13. Again the division comes out even (5,122 divided by 13 is 394). This final result is written on a slip of paper which is folded and handed to you. Without opening it you pass it on to spectator A.

"Open this," you tell him, "and you will find your original three-digit number." Prove that the trick cannot fail to work regardless of the digits chosen by the first spectator.

* * *

Two missiles speed directly toward each other, one at 9,000 miles per hour and the other at 21,000 miles per hour. They start 1,317 miles apart. Without using pencil and paper, calculate how far apart they are one minute before they collide.

* * *

The answers will appear next month.

* * *

Here are the answers to last month's brain-teasers.

1. A = 10430
   B = 3970
   C = 2114
   D = 386
2. 93 feet
3. 1st trip = 15 m.p.h.
   2nd trip = 45 m.p.h.
   3rd trip = 90 m.p.h.
4. Eldest $ 75
   2nd $375
   3rd $525
   Hospital $825

The answer to the coconut problem is fifteen.

The most convenient device for solving the first logic problem is to use a matrix with vacant cells for all possible pairings in each set. One cell is needed for pairing names with jobs, and another is needed for pairing names with cities. Each cell is marked so as to show whether or not the combination is possible.

Premise 7 eliminates the possibility that Smith is the fireman, and Premise 2 tells us that Mr. Robinson lives in Los Angeles. Premise 3 and 6 inform us that the physicist lives in Omaha, but he can't be Mr. Robinson nor Mr. Jones (who has forgotten his algebra). Mr. Smith is therefore the physicist, and Mr. Jones must live in Chicago.

Premise 5 now permits us to identify the brakeman as Jones. Since the fireman can be neither Smith nor Jones, Robinson must be the fireman, and Smith must be the engineer.

The second logic problem left unanswered last month is best handled by three matrices: one for combinations of first and last names of wives, one for first and last names of husbands and one to show sibling relationships. Since Mrs. White's first name is Marguerite (premise), we have only two alternatives for the names of the other wives: (1) Helen Black and Beatrice Brown or (2) Helen Brown and Beatrice Black.

Let us assume the second alternative. White's sister must be either Helen or Beatrice. It cannot be Beatrice, because then Helen's brother would be Black; Black's two brothers-in-law would be White (his wife's brother) and Brown (his sister's husband); but Beatrice Black is not married to either of them, a fact inconsistent with premise 4. Therefore White's sister must be Helen. This in turn allows us to deduce that Brown's sister is Beatrice and Black's sister is Marguerite.

Premise 6 leads to the conclusion that Mr. White's first name is Arthur (Arthur Brown is ruled out because that would make Beatrice prettier than herself, and Arthur Black is ruled out because we know from premise 5 that Black's first name is William). Therefore Brown's first name must be John. Unfortunately premise 7 informs us that John was born in 1868 (50 years before the Armistice), which is a leap year. This would make Helen older than her husband by one day more than the 26 weeks specified in premise 3. (Premise 4 tells us that her birthday is in January, and premise 3 tells us her husband's birthday is in August. She can be exactly 26 weeks older than he if her birthday is January 31, his on August 1, and there is no February 29 in between!) This eliminates the second of the two alternatives with which we stated, forcing us to conclude that the wives are Marguerite White, Helen Black and Beatrice Brown. There are no inconsistencies because we do not know the year of Black's birth. The premises permit us to deduce that Marguerite is Brown's sister, Beatrice is Black's sister, and Helen is White's sister, but leave undecided the first names of White and Brown.

In the problem of the stamps on the foreheads, B has three alternatives: his stamps are (1) red-red, (2) green-green, or (3) red-green. Assume they are red-red.

After all three men have answered once, A can reason as follows: "I cannot have red-red (because then C would see four red stamps and know immediately that he had green-green, and if C had green-green, B would see four green stamps and know that he had red-red). Therefore I must have red-green."

But when A was asked a second time, he did not know the color of his stamps. This enables B to rule out the possibility that his own stamps are red-red. Exactly the same argument enables B to eliminate the possibility that his stamps are green-green. This leaves for him only the third alternative: red-green.

(Brainteasers courtesy of Scientific American)

TOMORROW BEGINS TODAY AT CONVAIR SAN/DIEGO FOR YOUNG ENGINEERS AND SCIENTISTS

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Within the twenty-four pages of this brochure, you will find detailed information about Convair, the General Dynamics Corporation, and the work of each group within the Convair/San Diego engineering Department.

Whether or not you decide to discuss your career with us in more detail, we sincerely believe you will be better equipped to make your decision after reading this brochure.

If your placement office does not have a copy, we will be pleased to mail you one. Simply write to Mr. M. C. Curtis, Industrial Relations Administrator, Engineering,

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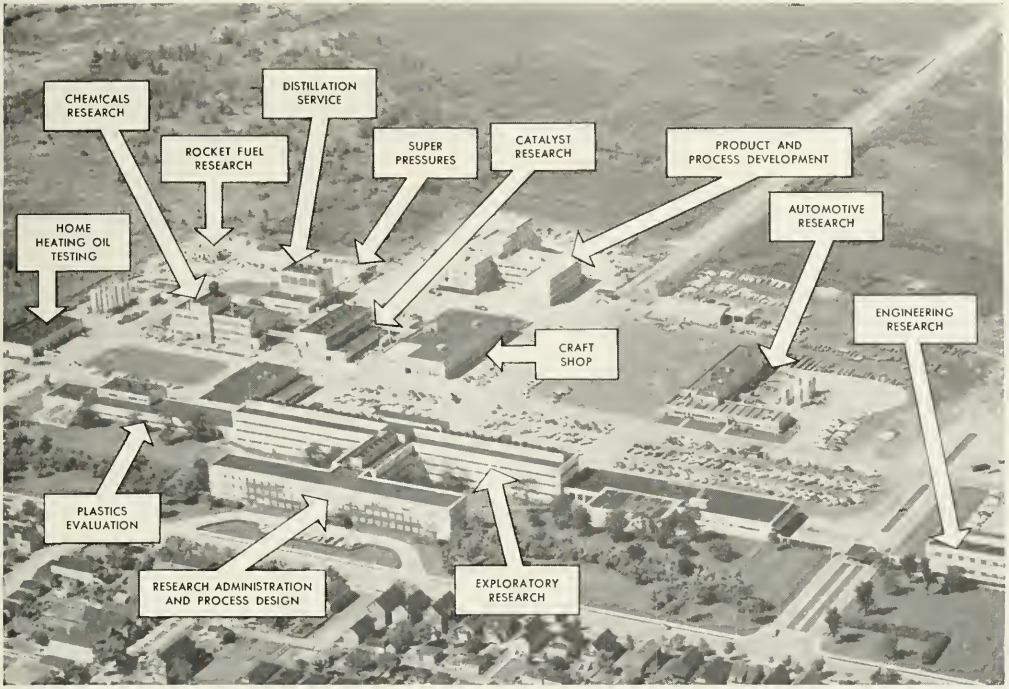

This huge research center at Whiting, Indiana, is only part of Standard Oil's research facilities. A recently completed technical service and quality control laboratory, not shown here, is the largest laboratory of its kind in the country. In addition, large research laboratories are operated by several affiliates.

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From time to time, we are asked if gasoline and oil today really are better than they were five or ten years ago. People can't see the difference, smell it, or feel it.

The answer is an emphatic yes. And this aerial view of Standard Oil's research center at Whiting, Indiana, is graphic evidence of the extensive research work that goes on behind the scenes day in and day out.

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Since our first research laboratory opened 69 years ago, research scientists of Standard Oil and its affiliated companies have been responsible for many major petroleum advances —from making a barrel of oil yield more gasoline to discovering a way to revive almost-dry wells. Each process had the effect of adding billions of barrels to America's oil reserves.

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To the young engineer and scientist who questions present hypotheses and who can combine unorthodox perception with imagination, Sylvania extends a climate of achievement. From these men, Sylvania foresees a number of tomorrow's breakthroughs. If your ambition is to attain your fullest professional potential, these facts about Sylvania—one of the world's fastest growing industrial organizations—merit your close attention.

Started as a basement industry manufacturing incandescent lamps only 59 years ago, Sylvania today has 23 laboratories and 46 plants located in 14 states across the nation. These 69 modern facilities afford employment to over 30,000 people. In the last 25 years sales have climbed from $6,000,000 to over ⅓ of a billion dollars. Strong as this industrial base is for the engineer and scientist, it was substantially reinforced in February 1959 when Sylvania merged with General Telephone Corporation. The merger of these two growth companies will:

- Increase ability to finance future growth and development
- Add further diversification to already broad commercial and defense product lines
- Measurably increase research and development facilities
- Give Sylvania the benefit of General Telephone's wide experience and background in foreign manufacturing and sales.

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Sylvania's success and reputation have long been based on the belief that the success of the organization depends upon the personal success of the individual. The engineer/scientist-oriented management has given much thought and study to provide an environment that kindles self-expression and creativity. Here you are assigned to a position where you can direct your training toward its greatest potential. Promotion from within the company gives impetus to your professional progress; assignments are frequently reviewed.

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The success of Sylvania in the advanced areas of electronics has been maintained over the years by scientific and engineering excellence. Sylvania's encouragement of uninhibited technological thinking has led to a number of important breakthroughs across many technologies, such as: Data Processing Systems; Computers; Semiconductors; Electronic Flash Approach System; Space Technology; Ceramic Stacked Tube; Electroluminescence; Bonded Shield Television Picture Tubes; Sarong Cathode Coating; First 110° Television Set.

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Begged, Borrowed, and . . .

Edited by Jack Fortner

Engineer's Glossary

It is in process—So wrapped up in red tape that the situation is almost hopeless.

We will look into it—By the time the wheel makes a full turn, we assume you will have forgotten about it also.

A program—Any assignment that cannot be completed by one telephone call.

Expedite—To confound confusion with commotion.

Channels—The trail left by interoffice memos.

Coordinator—The guy who has a desk between two expediters.

Consultant, Expert—Any ordinary guy more than 50 miles from here.

To activate—To make carbons and add more names to the memo.

To implement a program—Hire more people and expand the office.

Under consideration—Never heard of it.

A meeting—A mass mulling by master minds.

A conference—A place where conversation is substituted for the dreariness of labor and the loneliness of thought.

Under active consideration—We are looking for it in the files.

To negotiate—To seek a meeting of the minds without the knocking together of heads.

Re-orientation—Getting used to working again.

Reliable source—The guy you just met.

Informed source—The guy who told the guy you just met.

Unimpeachable source—The guy who started the ugly rumor originally.

A clarification—To fill in the background with so many details that the foreground goes underground.

* * *

Three tourists were standing on a street corner in North Africa. They were an Englishman, an Arabian, and an American. Just then a beautiful woman walked by. The Englishman said, "By jove!" The Arabian said, "By the prophet." The American just shifted his chewing gum and said, "By midnight!"

A meek little man walked into a barroom and ordered two drinks from the burly bartender. He drank one of the drinks and poured the other into his shirt pocket. After about ten rounds of this procedure the bartender says, "Pal, why are you pouring the other drink into your shirt pocket?"

The little man jumped up into the bartender's face and snarled, "Mind your own business, you big bum, or I shall come over the counter and whale the fire out of you." About that time a blurry-eyed mouse stuck his head out of the man's shirt pocket and said, "That goes for your damned cat, too."

* * *

During the recent California drought everything was so dry that the trees were going to the dogs.

* * *

Professor Lewellyn Rubin looked toward the next green, waggled his driver confidently, and declared, "That's good for one long drive and a putt." He gave his club a mighty swing, blasted up about two inches of sod, and managed to get the ball about three feet from the tee.

The caddy stepped forward, handed him his putter, and suggested, "Now, for one helluva putt."

* * *

Did you ever hear the story about the farmer who was milking a cow on the side of a mountain? He slipped and fell and would have gone down 500 feet if he didn't have something to hang onto . . . the poor cow saved him but the neighbors thought it was an air raid.

* * *

"The editor just hanged himself."
"Have they cut him down?"
"Not yet. He isn't dead."

* * *

Little Jack Horner
sat in a corner
Crib notes under his eye.

He opened his book
And took a quick look,
And now he's a Tau Beta Pi.

* * *

Pop Robin returned to the nest and proudly announced that he had made a deposit on a new Buick.

Three football players at different schools had flunked their classes and were dropped from the team. They got together and talked about their misfortune. The man from O.U. said, "That calculus was just too damn much." The man from S.M.U. said, "It was trig that got me." The guy from U. of I. said, "Did yourse guys ever hear of long division?"

* * *

Statistics show there are three classes of coeds—the intellectual, the beautiful, and the majority.

* * *

Two be-bops while traveling in Russia, saw a guy being flogged in a public square.

"I don't dig the beat," said one, "but that sure is a crazy drum."

* * *

Two old ladies were enjoying the music in the park. "I think it's a Minuet from Mignon," one said.

"I thought it was a waltz from Faust," said the other.

The first went over to what she thought was the board announcing the numbers.

"We're both wrong," she said when she got back. "It's a Refrain from Spitting."

* * *

He was a rather undersized freshman at his first college dance, but despite his smallness and bashfulness he was sure of himself in his own way. He walked over to a beautiful and oversophisticated girl and said, "Pardon me, Miss, but may I have this dance?"

She looked down at his small size and lack of fraternity pin and said, "I'm sorry, but I never dance with a child!"

The freshman bowed deeply and said, "Oh I'm sorry, I didn't know your condition."

* * *

U. of I.! What a football team!! What an attack!!! Even their breath is offensive.

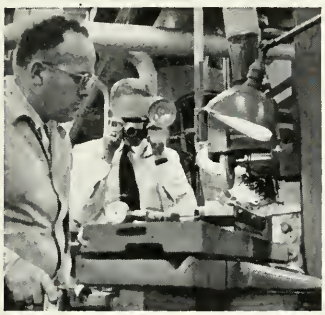
* * *

A woman is getting older when she begins to worry more about how her shoes fit than her sweater.

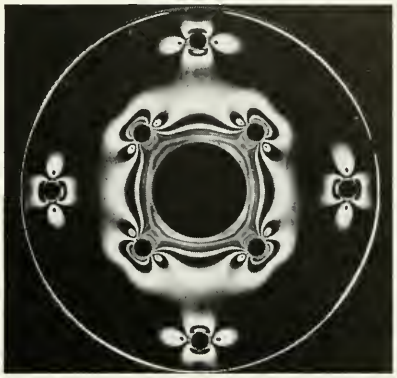
* * *

Now go back and read the rest of the magazine!

From research to finished product–
Photography works with the engineer



Sparks fly as the plant photographer records a grinding technique for study.



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One of a series*

Interview with General Electric's
Charles F. Savage
Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies —mature, knowledgeable men— have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

*LOOK FOR other interviews discussing: Salary • Why Companies have Training Programs • How to Get the Job You Want.

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